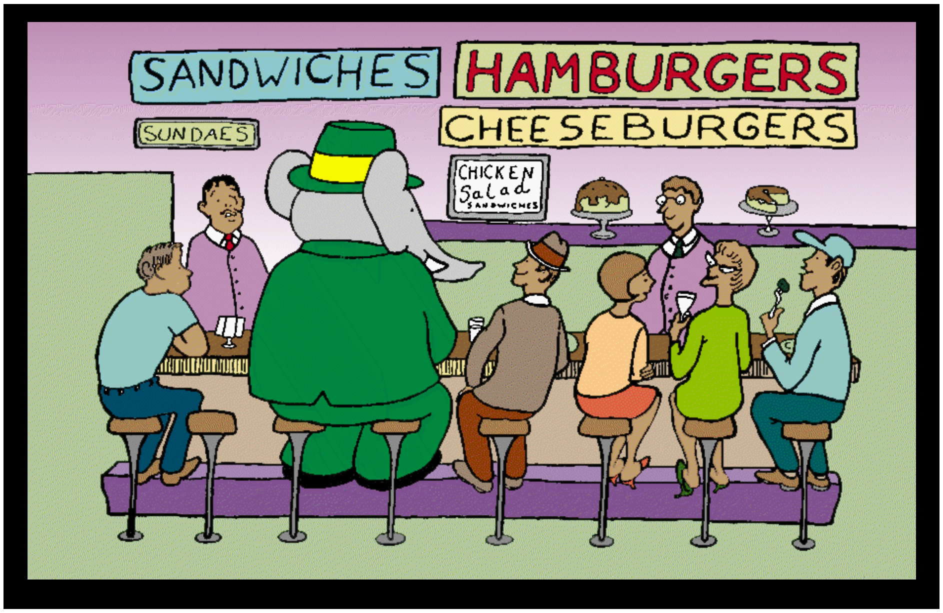


Figure 1: Babar Characters TM and copyright © Laurent de Brunhoff.

The Care and Feeding of BaBar

The BaBar Collaboration

April 3, 2008

This manual is stored in the BaBar CVS repository as the project CareAndFeeding.

What this manual is.

This manual is an attempt to put in one place all the directions for how to keep the BaBar detectors, electronics and computers running.

Some error messages which are reported on the console workstations can be looked up in here where it explains the problem and tells what to do.

There are instructions on how to do various hardware diagnostics and how to interpret the results.

There are instructions on how to change various VME modules.

What this manual is not.

Although it gives step-by-step directions on how to locate and fix problems, it is not a replacement for thinking. There are too many different things that can break to anticipate them all here.

This is not a bible. Don't blindly follow directions. THINK

GENERAL PHILOSOPHY

Two things never break at the same time. *Mosely's Law*

So if you ever conclude that two things are responsible for a problem, you have very likely made a mistake. Call an expert.

If after an hour you haven't made significant progress towards fixing a problem and as a result are losing data, call an expert.

The directions given here not only tell WHAT to do, but try to explain WHY it is a reasonable thing to do. If you don't understand how something works or why you are directed to do something, then call an expert.

Don't jump to conclusions. Be very cautious about changing modules. For example, a ROM test failing does NOT mean a ROM is bad. Something could be wrong with VME or the power supply could be off. It's often useful to check the crate status before paying attention to some other error message.

Our electronics doesn't fail very often. Try to get a test failure to repeat itself before jumping to conclusions and changing a module that is known to be fairly reliable.

If you change a module and the problem goes away, put the old module back in to verify that it was really the cause of the problem .

If you change a module and the problem does not go away, put the old module back in to keep things simple and to keep problems from spreading.

Feel free to mark up this manual with your suggestions for improvements. Even better make the changes yourself (see below). Or you can send email to the Care and Feeding hypernews group by clicing here.

References

Some other sources information on the BaBar detector are:

BaBar Technical Design Report	SLAC-R-95-457, 1995
(Many details are obsolete, but it gives a good overview.)	

Some useful online documents (... means http://www.slac.stanford.edu):

Safety web pages	.../BFROOT/www/Organization/Spokesperson/safety/safety_checklist.htm
BaBar detector web pages	.../BFROOT/www/Detector/Detector.html
SVT power supplies	.../ babarsvt/psupply/powersupply.html

Modifying and Linking to this Manual

0.1 Modifying this Manual

0.1.1 Organization

This manual is stored in BaBar's CVS repository as the package CareAndFeeding. If you have setup the standard BaBar environment as defined on the web page BaBar Computing Environment, the command, `cvs co CareAndFeeding`, will create the directory CareAndFeeding in your current directory and fill it with the source files. The master file is is care.tex, which contains embedding commands for each chapter. In the postscript version the names of the chapter files are given in even page headers. The chapter files all have the form c-xxxxxx.tex. Each chapter consists of sections. A few chapters have some of their sections in separate files. The names for these files have the form s-xxxxxx.tex. If you add a new section, please follow the pattern of LaTeX commands used in the other sections. If you add new chapter file, you must put the appropriate `\myinclude` command in the appropriate `latexonly` section and `\include` command in the corresponding `htmlonly` section of `care.tex`.

In your chapter file please follow the pattern of LaTeX commands in the existing chapters. In addition to the use of the macros `\chapter`, `\section`, and `\label`, note the heavy use of list environments to put the material into step by step or outline form. The LaTeX graphicx package is used to include graphics. Documentation for this package can be found in SLAC's TeX directory. LaTeXś makeindex facility is used. Insert `\index` statements at items you want indexed. There is a glossary chapter in which to define any terms (system jargon?) which may be unfamiliar to shift people.

The last page of the html version has links to the LaTeX2`HTML` documentation. This documentation explains how to insert links and graphics.

0.1.2 Commands defined for the CareAndFeeding Manual

There are a few useful commands defined specifically for this manual. Look in the c-expert.tex file for examples of the use of `\bbpname`, `\bbpnumber`, `\pager`, `\outpager`, `\cellpager`, `\outcellpager`, and `\telalert`.

0.1.3 Generating a new release

LaTeX and LaTeX2HTML are installed on SLAC UNIX machines. *DO NOT* define any TeX environment variables! The installation will find all the files it needs without assistance. (TEXEDIT is an exception, feel free to define it as you wish.)

Issue the *gmake* command to process the manual. The makefile has instructions to generate the postscript, pdf, and html versions. Find the postscript version as ./care.ps, the pdf version as ./care.pdf. Find the html as ./care/index.html. Note that the makefile has an operating system (*$OSTYPE*) dependent branch for the *.pdf* generating step. Solaris platforms use *distill*, which is not available on linux. Try Non-Solaris machines use *ps2pdf*. *ps2pdf* uses ghostsrcript, which is not a UNIX filter. Therefore a large intermediate postscript file is generated on /tmp/. The ghostscript produced file may not look as good on the screen as that produced by distiller, but it prints fine. The process is faster on a noric than on a tersk and, on the basis of small statistics, appears more tolerant of weird postscript files.

Once you are satisfied with your updates, do the following sequence of commands: `cd` to the CareAndFeeding directory. Do a `cvs update`. Proceed only if there are no conflicts (otherwise resolve the conflicts by hand). Do a `gmake`. Proceed if there are no errors; some warnings are normal. The next two commands require `afs` write access to the BaBar directories. You may do the command `publish`. This copies the postscript, pdf, and html to the public directory. Be careful that this command completed successfully. Use a web browser to check the published result since the publish script is primitive and has no protection. If you prefer, this publish step may be skipped, and the (human) editor will take care of it. Lastly do a `cvs commit -m ''a brief comment''`. Commit early and often to avoid conflicts.

0.1.4 Tools for converting existing documentation in html format

The script, `html2ltx`, will will partially convert typical how-to web pages to latex. It uses the `sed` scripts `html2ltx.sed` and `ltxcln.sed`. The usage is `html2ltx fname`, where `fname` does not include the expected `.html` extension. The output will be `fname.tex`. To get the file in the correct form for conversion, bring up a printable version on a UNIX based browser, then save it to a file.

The script currently handles headings, lists, some rules, paragraphs, and links. It partially converts tables and graphics. Linked tables of contents at the head of the file are redundant since LaTeX2HTML will generate these itself.

0.1.5 Graphics

Graphics are the most problematic part of using LaTeX. The first advice is to use them only when essential. Remember, that in many cases, people will be looking at the illustrated object while reading the manual. If the graphic contains no annotations, it may be redundant.

Because the SLAC installation of LaTeX2HTML uses `dvips`, all graphics must be in postscript. If you are generating screen captures using `xv`, save the captures as postscript files. If you already have `gif` files, use the `giftops` utility in the CareAndFeeding package to convert them to postscript. (Let me know if there is better utility for this purpose.) If you use `html2ltx` and `giftops` to convert an existing file, you may need to do some hand editing of the graphics entries to resolve issues related to size and orientation.

The LaTeX packages `floatfig` and `wrapfig` permit wrapping text around figures. `floatfig` does not seem to work with the `graphicsx` package used in the manual. `wrapfig` is used in the chapter on non-system devices. It is less than ideal since good results are not robust against text changes and LaTeX`2HTML` does not implement the wrapping feature. `wrapfig` is currently used.

0.2 Linking to this Manual

Web pages may link to locations within this manual. Such a location must have been declared with a `\label` declaration. Lets suppose there is a place labeled "injury". The URL to link to this location is
http://www.slac.stanford.edu/cgi-bin/l2hredirect/BFROOT/www/Detector/Operations/CareAndFeeding/care?injury . Most chapters are labeled with their file name minus the "c-". Most sections are labeled, but not in a systematic way. New labels must be unique throughout the manual.

Contents

IV WHAT TO DO WHEN ...

Part I

EMERGENCY PROCEDURES, GENERAL SAFETY

Compulsory reading for Everybody!

What to do

- during an Evacuation Alarm ?
- in an Emergency ?
- to maintain safety ?

Nearly all BaBar activities require training. The training program is described in Spokesperson's safety web pages at .../BFROOT/www/Organization/Spokesperson/safety/safety_checklist.htm. All shift people are required to have completed basic BaBar training plus shift person's training and to have read, understood, signed, and filed appropriate routine and shift takers JHAMs. Many activities at BaBar require additional task specific training. The next three chapters on safety assume the training has been completed, but provide an outline of the most important safety policies for reference purposes. Please review these chapters before each new set of shifts.

Chapter 1

EVACUATION ALARMS

A LOUD KLAXON ANNOUNCES AN EVACUATION ALARM.

ALL PERSONNEL ARE REQUIRED TO LEAVE THE BUILDING IMMEDIATELY BY THE MOST DIRECT AND SAFE ROUTE.

1.1 Responding to an EVACUATION ALARM

LEAVE THE HALL IMMEDIATELY. There are separate alarms for building 620 (the Hall, including the EH and the IP area), building 621 (the counting house, including the Control Room, conference room, kitchen, and maintenance area), and the building 636 (the gas mixing shack). Both 620 and 621 should be evacuated in case of an alarm for either.

1. People in the BaBar staging area or Electronics House should leave by way of the nearest exit.

2. People in the IP area should leave through the Control Room or leave by way of the South Arc tunnel, exit at the South access tunnel, and return to the assembly area to be accounted for.

3. People in the Control Room should not exit through the BaBar Hall if the fire alarm has gone off for the hall. The fluorinert used in the EMC chillers may give off a highly toxic gas when burned.

4. Everyone should evacuate the building under the direction of the Person In Charge (PIC) (see 2.1) or the BaBar Pilot, (see 2.2) and then should assemble on the road leading down to 620 from the ring road, at a safe distance from the building.

5. In the case of a Hall only alarm, the BaBar Pilot should check the alarm annunciator panel in the control room (top left of the console). This will indicate which, if any, of the VESDA (Very Early Smoke Detection Apparatus) units triggered the alarm.

There are four VESDA smoke alarm heads. The fire people sometimes call a detector head a "scanner". Each head samples four pipes. The fire people sometimes call the area served by a pipe a "sector," and sometimes they call it a "zone." Scanner 1 serves the electronics house (EH), scanner 20 serves the detector, and scanner 3 serves the Hall, the adjacent tunnels, and the forward RPC racks. Another scanner samples the LST racks. There are also standard smoke detectors which are not connected to this panel, notably those for the general interior of the EH, for building 621 (the counting house), and for the assembly area of the Hall. Don't linger more than a minute on this task before evacuating. Everyone else should be out by the time you finish.

6. Gas Mixing Shack (GMS, building 636) fire alarms coming from the Hazardous Atmosphere Detectors (HADs) will appear on the alarm annunciator panel as a CEN-GMS alarm without a GMS-Vent alarm. GMS fire alarms due to a smoke detector may show up in a similar way, or may not register in the control room at all. If it is due to a HAD, the IFR and DCH gas system experts should be paged, and the duty cryo-tech contacted.

7. The BaBar Pilot should make sure that there is someone at the ring road, near building 625, to guide the emergency vehicles. The fire fighters may enter the building via the stairs leading from the ring road level to the maintenance area in the counting house.

8. Beam may continue to circulate in PEP as long as the BaBar radiation protection system (both fast abort and EPICS based slow abort) are operational. These may be monitored at MCC by the liaison and/or the accelerator operators. PEP has its own fire protection system which will warn the accelerator operators of hazards to the machine.

9. The BaBar Pilot should assist the PIC in shutting down equipment if the PIC decides that such action is necessary and can be undertaken safely.

10. After the arrival of the Fire Department personnel, employees should only assist when they are asked to do so by the PIC.

After everyone has been evacuated from the building, Stage II of the Alarm response begins:

1. The PIC will assume overall control of the situation.

2. All SLAC personnel will assist the Emergency Response personnel in any manner requested in order to stabilize the situation and assure that safe reentry to the building becomes possible.

3. The PAFD will silence the alarms as soon as all people are accounted for and have left the endangered area.

4. With the approval of the PIC, the control room may be re-entered and all detection system indicators recorded and made available to the PIC.

5. General reentry will be initiated by the PAFD after confirmation that no fire is present anywhere in the building or immediately outside. If there was a fire, one can expect the release of some amount of toxic and/or corrosive gases, and thus that people should not re-enter without assurance that the atmosphere is safe.

1.2 About the Alarms

The PEP IR2 Hall (Building 620) is equipped with a general, i.e. Hall wide fire alarm system. This system is separate from the counting house (Building 621) system. In case of an alarm in either building, both need to be evacuated.

Smoke detectors, heat sensors, or manual pull alarms, will trigger an EVACUATION ALARM which will be announced by a LOUD KLAXON, and flashing strobe lights that are mounted high in the Hall.

The system automatically notifies the Palo Alto Fire Department (PAFD) station at SLAC and at their dispatch center in Palo Alto. MCC also has a direct indication of the origin of the alarm.

Smoke detectors are located on the BaBar detector, inside the Electronics House, and throughout the building. Smoke detection anywhere in the building will trigger the alarm, so a person cannot easily determine his/her proximity to the fire, unless he/she is very close. The PEP IR2 Hall, Control Room, Maintenance Area and the Electronics House interior are protected by sprinkler systems. Temperatures exceeding $74°C$ at the sprinkler heads will activate the sprinklers. In addition the racks, in and on top of the Electronics House, are protected by an FM200 fire suppressant system. Smoke detection in the Electronics House Racks will shut down power to the bank of racks in question. Higher smoke levels will trigger the fire alarm and call the fire department. Still higher smoke levels will trigger the FM200 system.

Note that the VESDA smoke detectors are very sensitive to any light scattering particulate in the air. Any dust generating work needs to be coordinated with the fire alarm technicians.

If you discover a possibly hazardous condition you should call the PAFD at x9911 and MCC at x2151. If you don't have time to call, you can also initiate an EVACUATION ALARM by pulling one of the red alarm boxes near the building exits.

Chapter 2

EMERGENCY

A variety of emergency conditions may interrupt the normal operation in the PEP IR2 Hall (Buildings 620 and 621). The following list includes some possibilities:

1. FIRE, smoke, explosion, etc.
2. CRYOGENIC HAZARD
3. RELEASE OF HAZARDOUS GASES
4. SERIOUS EARTHQUAKE, flood, water damage, landslide
5. PERSONAL INJURIES, electric shock, asphyxiation, etc.
6. FAILURE OF ELECTRIC POWER, water, compressed air, etc.
7. THREATS TO THE LABORATORY

Fire will be detected by sensors distributed throughout the building and will be announced by a LOUD KLAXON and demands immediate evacuation of the building (Section 1.2). All of them require that you assist in reducing the probability of personal injury to you and anybody else and in minimizing the potential damage to the property and equipment that is installed in the area. This means that you have to be familiar with the basic emergency procedures and with the safety installations in the IR2 Hall.

Most of the rules and regulations concerning emergency procedures are common sense and straight forward, and this is not accidental. The basics will be spelled out here for reference.

2.1 Person in Charge (PIC)

During emergencies the PERSON IN CHARGE of the laboratory is

- a) the MCC Engineering Operator-in-Charge (EOIC, x2151; cell: 283-9700; pager: 424-7846) when the accelerator is operating, or

- b) the Fire Department Senior Officer (x2776) when the accelerator is NOT operating.

The principle tasks of the PIC during an emergency at SLAC are as follows:

1. to serve as a central communicant, receiving and issuing information relative to the emergency,
2. to evacuate personnel from the areas where potential hazards continue to exist.
3. to call for fire, police or medical assistance and to notify key SLAC and outside personnel;
4. to see that proper directions are provided to the emergency vehicles and personnel proceeding to the scene of the emergency;
5. to maintain liaison with fire, and medical officials, to provide advice and support for their efforts, and to relinquish authority necessary in their area of responsibility;
6. to maintain a chronological record of events preceding, during and following the emergency.

Obviously, the full scope of these responsibilities may not be pertinent to every emergency. The PIC will use his/her judgment and experience in deciding upon the extent of his actions in any given event.

Generally, a minor injury or minor damage to equipment occurring during daytime can be handled by the supervisors in the area and by SLAC safety or medical personnel who are on site. A more serious accident occurring during the day or any emergency outside regular working hours will necessarily require more involvement of the PIC.

2.2 Responsibilities of the BaBar Pilot

In all emergencies in the BaBar area, the senior, i.e. more experienced, person of the BaBar shift team should consider himself/herself to be in charge at the scene and assist the PIC in his duties. In particular, the BaBar supervisor is responsible for:

1. Seeing that those under his supervision are familiar with the plan for the building, particularly the recommended exit routes, as well as the Personnel Protection System (PPS) system.
2. Contacting the PIC at MCC during an emergency to provide the necessary information and rendering whatever assistance the PIC might require.

2.3 BaBar Safety Officer

As for the rest of SLAC, safety in BaBar is the responsibility of the people doing the work and their supervisors. The BaBar Safety Officer is available to assist you. The current Safety Officer is Frank O'Neill (x5300). Please, contact him if you have questions, criticism or worries about any aspect of the safety in the IR2 Hall.

2.4 IR2 Building Manager

Sandy Pierson (2686, pager 424-7654) is Building Manager for PEP IR2. Jim Krebs assists in matters related to the BaBar modification and maintenance.

The Building Manager for IR2 serves primarily to coordinate with the BaBar safety officers those activities that are essential to:

1. the prevention of fires and accidents,
2. the response to emergencies, and
3. the maintenance of high standards of cleanliness and order.

In the event of a major earthquake, the building manager will act as a local coordinator of the site-wide emergency plan.

2.5 SERIOUS EARTHQUAKE

In case of a serious earthquake your response should depend on the your exact location.

1. If you are inside the Electronics House, Control Room, or Maintenance Area of the building,
   (a) stay in the room,
   (b) avoid falling debris and breaking glass by moving away from unanchored objects and glass windows or doors,
   (c) stand in a doorway or corner of the room, or crouch under a table or desk.
2. If you are in the IR hall or IP area,
   (a) try to get to the exit tunnels or end walls, or location where you might be safe from scaffolding, piping, and cable trays.
   (b) Stay there and wait until the tremors are over.
3. If you are outside,
   (a) stay outside.
   (b) move into open areas away from the walls of the IR buildings, the utility pad, the gas trailers, and other unstable structures.
4. After the earthquake:
   (a) Be careful there may be aftershocks,
   (b) Do not smoke! Do not light matches! Do not operate electrical equipment!
   (c) Try to stay away from electrical wires and switches, broken glass and other structural hazards.
   (d) Listen for instructions from the PIC over the PA system.
   (e) Evacuate the building if instructed to do so by the PIC or by safety personnel or after severe shaking (e.g. books falling off shelves) has ceased.

2.6 PERSONAL INJURY

1. Call x9911 to report the injury and summon medical aid. Specify the location and the nature of the emergency. Paramedics with all the necessary equipment are available on site at all times.

2. If you are qualified to give first aid, do so if the case requires such assistance. Make sure that such action will not aggravate the victim's injuries.

3. Unless an exposure to greater injury exists at the scene, no attempt should be made by non-medically trained persons to move a victim, specially if he/she appears to have sustained broken limbs or injuries to the head or back.

   CAUTION! In cases of electric shock extreme care is advised since the victim might still be in contact with a live electrical circuit.

4. Heavy bleeding must be stopped! If strong bleeding is involved, or if circulation has stopped, provide first aid at once if you feel competent.

   YELL FOR HELP! Do not delay assistance by going to the phone yourself, but instruct a bystander to report the injury and summon medical help.

5. Continue first aid measures and stay with the victim until professional help arrives.

6. Report the injury to MCC.

7. Report the injury to the medical department at the first practical opportunity.

If the injury is not serious enough to require paramedics, but nevertheless requires emergency treatment, get someone to transport you to the Stanford Hospital emergency room. The entrance to the emergency room is on Quarry road near its intersection with Campus Dr. If the injury does not require immediate treatment, report to the medical department if it is during work hours. Otherwise make your own arrangements for urgent care, and report the injury to the medical department at the first opportunity. All significant injuries should also be reported to MCC. The medical department will give you injury report form to fill out and have signed by your supervisor. For most visitors, the Run Coordinator may be named as supervisor.

2.7 ELECTRIC SHOCK

1. Make sure the person is not in contact with an electric circuit. If yes, de-energize the circuit. This can be done by simply pulling the plug or hitting the red crash button (in the Electronics House or on top of the detector), or, if you are familiar with the AC power distribution, turning off the main breaker in the appropriate circuit breaker panel board. If this is not possible, a last resort may be to remove the person using a non-conducting object like a wooden pole or a piece of rope or clothing.

2. Phone x9911 to summon medical help. Have somebody meet the emergency personnel and escort them to the site of the accident.

3. Administer first aid immediately if qualified to do so. CPR may be necessary. Continue first aid until successful or until another competent person relieves you.

2.8 RELEASE OF TOXIC, FLAMMABLE OR CRYO. GASES

1. Anyone detecting a leak of a flammable or toxic gas, or a substantial release of cryogenic fluid should call the PAFD at x9911 and MCC at x2151 (cell: 283-9700; pager: 424-7846) and report the condition.
2. You should evacuate the building. In case of a major spill of cryogenic liquid your exit route may be blocked and you may decide that it would be safer to try and escape the cold and asphyxiant white cloud of heavy gas by climbing to a higher elevation. If at all possible, use the emergency exits.
3. In case you suspect a flammable gas, all non-emergency electrical power should be shut off immediately. The HAD system, if active, may confirm the presence of a flammable gas in the area.
4. Only trained and properly equipped emergency personnel may enter the area until it has been checked and cleared.

2.9 FIRE OR SMOKE RELEASE

1. The Control Room, Maintenance Area, Electronics House, and the IR2 Hall are equipped with smoke and heat sensing devices. If smoke or heat is detected anywhere in the Counting House, the Electronics House, or the Hall areas, a general fire alarm will be triggered, and the KLAXON will request EVACUATION of buildings 620 and 621 (the Hall is building 620 and the counting house, including the control room, is building 621). In most cases you will not know where the alarm originated.
2. If you detect a fire or smoke, first call the PAFD at x9911, then be certain that nobody is in immediate danger, then call MCC at x2151 (cell: 283-9700; pager: 424-7846) to report the condition. Specify the exact location.
3. If a smoke detector triggers the Klaxon, the PAFD will be notified automatically. The PAFD will able to identify IR2 as the location where the alarm originated and the emergency vehicles will be sent immediately. In MCC there is a similar panel as in the fire station, so the EOIC finds out about the alarm and is able to proceed directly to the alarm point, arriving there at the same time as the fire engine.
4. CO2 fire extinguishers are placed throughout the building, inside the Electronics House, and near the access to the exit in the IP, but only trained people should try to use them and only if the fire is very small. If you see large amounts of smoke develop, get out and let the fire suppression system handle it. Remember, cable insulation and many other synthetics produce highly toxic smoke.

5. The IR hall is equipped with a number of water sprinkler systems. There are also sprinklers below and above the Electronics House. There are no sprinklers over the detector proper.

6. If the temperature in any given area exceeds 74°C the sprinkler head fuse will melt, and the whole area will be drenched. This could also happen if any of the sprinkler heads is defective!

7. The inside of the racks in the Electronics House are protected by an FM200 (heptafluoropropane, aka HFC-27ea, a fire suppressant gas) system. The FM200 system is controlled by the VESDA smoke detection system which has four alarm levels. The first level ("alert") gives an early warning. The second level ("action") shuts down the power to the racks. The third level ("fire1") sets off the EVACUATION alarm (see Chapter 1) and calls the fire department. The fourth level ("fire2") discharges the FM200 into the bank of racks in which the smoke was detected. Let the FM200 do its job and leave the Room. FM200 will not damage the electronics, and is thought to be non-toxic, but it may be harmful to your lungs and breathing equipment. If there is an actual fire in the racks, the FM200 may break down and produce hydrogen fluoride.

8. The BaBar control room, kitchen and maintenance area upstairs have standard water sprinkler systems.

Chapter 3

SAFETY FIRST

3.1 General Comments from the SAD

The Safety Analysis Document for the BaBar Detector states that the BaBar operation presents a minor on-site and negligible off-site impact to people or the environment. The report classifies the hazard as LOW.

3.2 The PEP Interaction Region 2 Experimental Hall (IR2 Hall)

1. The Building – The PEP IR2 Hall is referred to as Building 620 on the SLAC site.

2. The Hall Area – The experimental Hall is 13.7 m high, 37.6 m long in the (designated) East-West direction and 21.1 m wide in the (designated) North-South direction. The PEP beam lines run North-South. The experimental Hall is divided into two regions by a concrete shielding wall. The BaBar "assembly area" is at the East end, the "interaction point [vault]" (the IP) is at the West end. The radiation wall is 14.1 m east of the west wall. It has to be up and the curtain wall in place at anytime beams are entering the PEP IR2 interaction region. The electrons enter from the North, the positrons from the South. The floor of the experimental Hall is 3.5 m below the beam line.

3. Cranes – There is crane coverage of both assembly areas and the vault by a 50 t crane (the auxiliary hook is 10 t). The maximum hook height 10.6 m. Operation of this crane is restricted to trained personnel.

4. Counting House – To the North of the Hall is a two story structure (the "counting house") containing the the control and conference rooms downstairs and lab space, kitchen, and rest rooms upstairs.

5. Access and Exits from the Halls – Access to the interaction point (IP) is via a short tunnel. Stairs also connect the floor of the IP to the beam housing of the PEP

tunnels, they also serve as emergency exits. Access to the outside from the beam housing is via short side tunnels. The South access tunnel is about 30 m, the nearest North tunnel access is at the SSRL building about 100 m from IR2.

3.3 Precautions for Working on the BaBar

The LOW HAZARD rating of the BaBar area can only be maintained with the collaboration of everybody working in the area. To maintain a safe environment is going to require vigilance and precaution on the part of everybody.

1. Hazards

   (a) The BaBar detector is high off the ground. Check-out of most components involves climbing up on ladders, scaffolds, etc. to elevations sufficiently high off the ground that a fall could result in serious injury or death.

   (b) During installation work the overhead cranes are often transporting substantial loads across the Hall.

   (c) A colleague working at a higher level may inadvertently drop a tool or an even heavier piece of equipment.

   (d) The IP is congested, sometimes making access awkward.

   (e) Many of us work in parallel during check-out, thus some systems may be on high voltage while others are being installed.

2. Safety Equipment.

   (a) Hard hats are kept in garbage cans near the entrances to the IR hall.

   (b) Harnesses are kept on the east wall near the roll-up door.

   (c) Flash-lights are kept in the secretarial supply cabinet in the Control Room.

   (d) Portable Oxygen Monitors are kept on the shelves behind the Console in the Control Room.

   (e) CO2 FIRE EXTINGUISHERS are mounted on the walls at many locations, in particular at the exit doors of the Electronics House and next to the entrances to the Hall. These are for use only on very small fires, and only by trained people.

3. Safety Rules for Working in the BaBar Hall.

   (a) *Training*: In addition to SLAC's employee orientation to safety safety and health (EOSH), General Employee Safety Training (GERT), and general electrical safety training (course 239). You will be issued a security badge and a dosimeter when you have completed GERT. You need to have completed a routine Job hazard And Mitigation form (JHAM). Shift people need to have taken the shifter's safety training, which is part of the general shift training. As part of this training, you will be filling out and signing, and getting approved a shifters JHAM.

Anyone who plans to work in IR-2 needs to have some orientation on the "rules of the game". Working above ground level is frequently required, and there are rules for this. It is essential to have a brief training session before working in the hall. This applies to everyone. The session only takes about 15 minutes, so it is not a burden. If someone has already had this training, but they have been away for quite a while, they should take it again, because many things have changed in the hall. Training sessions by Sandy Pierson are provided Wednesdays at 13:30 at the IR-2 conference room when there is demand. Check with Sandy. If you cannot come at one of those times, please contact Sandy Pierson (tele. 926-2686, page 424-7654, or e-mail esp@slac.stanford.edu) to arrange an alternative session. You will receive a star sticker for your security badge after this training is completed.

Almost any hazardous task requires specific training. For example there is ladder training, fall protection training, confined space training, and electrical safety for technical people (course 255).

(b) Keep safety foremost in your mind at all times. Never place yourself in an unsafe situation, nor even for a very brief time.

(c) Always wear a HARD HAT in the IP area. Wear a hard hat in the Hall if the hard hat required signs are out. This will be the case if there is overhead work or substantial rigging going on. If you work regularly in the Hall, please, purchase your own hat, they are stores items and cheap. Do not deplete the hard hat supply. They are there for general use and have to be returned there.

(d) If you feel unsafe or compromised with the existing scaffold or ladders, ask the Hall Manager to help you improve the situation. At least get his guidance when establishing your own support.

(e) Always look out for unsafe situations and do not hesitate to bring them to the attention of your colleagues involved, the Hall Manager, the Run Coordinator, the Operations Manager, a Run Coordinator, or the Safety Officer.

(f) Never work on the detector without somebody else in the area. Make sure that the BaBar shift Pilot is aware of where you are working.

(g) Never work with high voltage when you are alone! High voltage is anything 50V or more.

(h) Use a fall protection HARNESS (fall protection training required) when you are working in a location where you are not protected from a fall of more than four feet. You will feel much safer when you wear the harness and hook yourself onto the detector. Use an inertia-reel tether if available. This is especially important if the potential fall is small. Note that harness anchor points have to be approved by the chief mechanical engineer. Harnesses are kept on the east wall next to the roll-up door. Do not do work requiring a harness if no one else is where they can hear you call for help. Please BUCKLE UP!

(i) Never turn on a high voltage system or the magnet current without announcing this over the PA. In addition, make sure that there is nobody working on the system involved, and that everybody in the Hall and Electronics House knows about your intention and has time to respond appropriately. Beware, people may be hidden behind scaffolds and pipes and may need some time to respond. An exception to the HV rule is a system that has been verified to be secure with no exposed high voltage.

(j) Conversely, if you are working on the detector or any high voltage or high current system, make sure the BaBar Shift Pilot (see 2.2) is aware of your activity. It is best to leave a note in the logbook, and to remove the key from the power supply (if available) and to keep it in your pocket. Also, return the key and inform the BaBar shift supervisor when you are done or stopping for the day.

(k) The DIRC tunnel at the north end of the detector, through which the DCH electronics is accessed, is a Permit Required Confined Space (PRCS). Confined space training and a permit are required for access to this tunnel. The training will cover additional monitoring and safety watch requirements.

3.4 Radiation Safety

1. Permissible Radiation Levels

   It is and has always been SLAC's policy to maintain radiation exposures to personnel as low as reasonably achievable (ALARA). Areas with radiation levels exceeding 2 mrem/hour should be marked with signs. If you detect higher levels, stay away and get assistance in monitoring, marking and reducing the exposure by calling the Radiation Protection Field Operations (RPFO) at x4299 (after hours page 227-6362).

   The radiation exposure limits set by SLAC (they are all below the legal limit) are a yearly accumulated dose less than 100 mrem for people without Radiological Worker Training (RWT) and 1500 mrem for people with RWT. BaBar personnel are requested to carry film badges containing TLDs. They are checked only once per year because the normal radiation exposure to any of us is below the set limit of 100 mrem/year for 'yearly badges'. If an activity is expected to result in significant exposure, consult with someone with RWT.

2. Shielding The IR2 Hall is divided into two areas such that the IP (where the detector and PEP beam lines are located) is separated by one meter thick concrete walls from the BaBar staging area (where the electronics house (EH) and the chiller/heat exchanger apparatus is located). This will reduce the radiation levels in the staging area to safe and acceptable levels even for accidental beam losses. Access to the BaBar staging area will not be restricted during normal PEP operation.

3. Access to the IP Vault.

   (a) Access to the IP is controlled by the PEP II Personnel Protection System (PPS). This system is designed to keep personnel out of areas where radiation hazards exist. Its secondary function is to protect you from electrical hazards such as exposed magnet bus bars and terminals.

The PPS uses an extensive network of redundant interlocks to ensure that the area is safe to enter. In the case of the IP this means that several beam stoppers need to be inserted. The PEP operators at the Main Control Center (MCC) will see to this.

(b) Access to the IP vault is through an access module from the staging area. This modules is a standard double door with TV monitoring and a remotely controlled key bank. There is a light panel above the door indicating the Access Status. If you are not familiar with the PPS system, get somebody who is knowledgeable to enter the IP with you and have him/her explain the system to you. If you break or mishandle the interlocks this could cause a major interruption of machine operation! So be prudent.

The rules are the following:

i. In the 'PERMITTED ACCESS' mode unrestricted access is allowed. If the door is closed, push the 'Permitted Access' button at the door to open it.

ii. In 'NO ACCESS' mode, you should not attempt to enter. If access is mandatory in case of an emergency use the crash button. This will crash the beams and the complete interlock system, and may take hours to recover from.

iii. In 'CONTROLLED ACCESS' mode:

- Entering:
  - Call MCC, x2151, state your location (PEP IR2 IP entrance) and ask for permission to enter.
  - Everybody MUST carry a Thermoluminescent Dosimeter.
  - Each person requesting access must give their name (and number if they are on the access list). The operator needs to log the name of everybody going in, so if your name is not on the access list please spell it clearly and slowly; the communication over the phone or intercom is not always easy.
  - After the MCC operator has given his/her ok, he/she will release the keybank, and **each person entering removes one key from the bank**. Do not open the door until everyone entering together has a key. Each person retains their key until they exit.
  - One person will then use their key to open the door, allowing everyone to enter.
  - Make sure that the door is firmly closed behind you after the group has entered.
- Exiting:
  - Upon completion of your task inside the vault, exit through the same door as you entered.
  - Contact MCC, give your name, wait for the operator to release the door.
  - Exit and close the door firmly.
  - Insert your key in the key bank.

  - After all keys have been returned to the bank, and all work is completed in the IP, inform MCC, so the CONTROLLED ACCESS can be terminated and PEP operation can be resumed.

 iv. An access to the IP is a major interruption of the machine operation, so only the BaBar pilot should make the request for entry. In general this should not be done without consultation with the Run Coordinator, unless there is an emergency or a serious breakdown of BaBar equipment.

(c) In addition to the standard access module to the IP, there are two gates, one at the North and one at the South wall above the Hall level, separating the IP vault from the North and South arcs. These barriers permit us to carry out work on BaBar while the magnets remain energized in the PEP II Arcs.

(d) Anything that has been behind the shielding wall is assumed to be activated or contaminated until shown to be otherwise, even trash or detector components like electronics. Such objects must be surveyed by Health Physics before they are removed from the shielded area. This means that we can't bring electronics from the detector to upstairs at IR-2 directly without surveying. To facilitate the survey process, there is a Radioactive Materials Management Area (RMMA) marked by signs yellow ropes and signs in the assembly area. Items may be moved form the IP to this area while awaiting survey. Please remove them from the RMMA as soon as they are surveyed.

4. Radiation Monitoring

   (a) The SLAC Health Physics Department has radiation monitors placed throughout the building and in particular in the Hall areas. Some of these monitors are remotely read and interlocked with the beam to protect you and everybody else from direct radiation hazards as well as from possible equipment damage and unnecessary generation of radiation.

   (b) Access to the IR2 Hall requires that you carry a film badge. It contains a Thermoluminescent Dosimeter (TLD). This badge must be displayed on the front of your torso between the waist and neck. Please, do carry it on you at all times and have it replaced and checked once a year. If you suspect that you might have been exposed to an unusually high level of radiation, please contact the Operational Health Physics (OHP) department as soon as possible (x4299, after hours page 227-6362).

5. Visitors to SLAC

   Visitors, friends, family, colleagues, etc. are welcome at SLAC. They are permitted to enter the accelerator area as long as they are escorted. As an escort you are responsible for the visitor and you should observe the following rules:

   (a) Visitors must register at Sector 30 and receive a temporary ID card. If they are going to enter the IR Hall, they must obtain a visitor's film badge as well. It is the responsibility of the escort to make sure that this badge is returned to the guard after the completion of the visit, but no later than midnight the same day.

(b) When taking a visitor into areas of increased radiation marked off with ropes and signs by the Radiation Protection Field Operations (RPFO) personnel, check with RPFO or MCC for proper procedure.

(c) Visitors who are pregnant or under 18 years of age should not be taken into areas marked off with ropes and signs by the RPFO group.

(d) Visitors should be accompanied by an escort at all times when inside the security fence. An exception to this rule may be made during transit between the Sector 30 gate and IR2, provided the guard has phoned somebody who agrees to meet the visitor at the entrance to IR2 and to be responsible for him/her.

(e) During down-times, visitors are not allowed to tour the Hall without approval from the Safety Officer.

Part II

ROUTINE OPERATING PROCEDURES

- How to operate the detector
- How to take data
- How to manage the control room

Chapter 4

Duties of the Shift People

4.1 Summary of Shift Duties

There are currently two BaBar central shift people: the Pilot, and the Navigator. Under special circumstances there may also be a PEPII Liaison. The primary duty of the shift people is to collect data. For this data to be useful several other duties must be carried out to ensure the quality of the data and to maintain the integrity of the detector. Among these other duties are the communications with MCC, the cryogenics group (a part of the EFD, henceforth simply "cryo"), and SLAC support people, calibrations, the shift check, record keeping, detector monitoring, and securing the experiment when leaving it unattended. The details of these operations and the need for other activities is currently changing on a frequent basis. The most current description may be found on the web page Information for Shift Takers web page. Note that both the Pilot and Navigator must not wear sandals or other open-toed shoes while on shift. These are not allowed in the IR hall at any time and shifters must be prepared to enter this area whenever necessary.

The apparatus should be calibrated as required by the systems. Calibration procedures are described in Section 6.6. In addition to generating calibration constants this procedure checks the apparatus for proper function. It is up to the Pilot to arrange, with the PEP II Liaison, the necessary conditions.

The shift check should also be done once a shift, preferably near the beginning. A checklist may be obtained by printing the SHIFT CHECK web page.

Record keeping serves both to provide a readily accessible record of recent activity, and to help the shift people to stay alert to the condition of the experiment. Record keeping will be described in detail in Section 4.5.

4.2 Duties of the Pilot

The following is a list of duties required of the BaBar shift leader. They are listed in no particular order. The list is evolving, and suggestions are welcome.

1. Make sure all necessary processes are running (alarm handlers, BaBar epics, Shift leader epics, ORC, etc.).

2. Instigate a channel of communication between BaBar shifters and PEP-II operators. Ensure that beam conditions and accelerator activities are being recorded in the BaBar electronic logbook.

3. Understand PEP and BaBar activity plans for your shift and the next. Prioritize activities accordingly.

4. Identify on-call subsystem experts who are in the control room.

5. Coordinate any interruption of services to BaBar. See chapter 25 for instructions.

6. Coordinate any changes in the solenoid or bucking coil status with cryo and MCC.

7. Acknowledge and resolve all alarms (alarm handler and hardware).

8. Answer the phone ONLY on x5256 (other lines if you feel generous and only if it does not interfere with your other duties).

9. Arrange a time with MCC (i.e. no injection) and the detectors for all detectors that wish to run a calibration.

10. Make frequent (and clear) entries in the logbooks!

11. Enter any hardware problems which are either incompletely resolved, are likely to recur, or resulted in loss of data, in the Hardware Problem Tracking Database. The new report form may be accessed by clicking the “hardware remedy” button on the “problems” line of the electronic logbook.

12. Check notification lists (beam downtime, access, etc) and notify as appropriate.

In addition, the Pilot must carry out duties on the Data Acquisition System (DAQ). Chapter 6 describes these duties and how to execute them.

4.3 Duties of the Navigator

The following is a list of duties required of the BaBar Navigator shifter. The list is evolving and suggestions are welcome.

1. Understand how to run the most recent versions of the online fast monitoring for each subsystem.

2. Look at latest reference histograms from each subsystem and learn to recognize features of bad data.

3. When runs start, watch the accumulating fast monitoring data.

4. Help answer the phones so long as it does not interfere with your other duties.

5. Fill out the BaBar shift checklist.

6. Watch, learn and participate – the point of the Navigator shift is to learn the ropes of shift-taking in IR-2. Observe and understand the work of the Pilot (you should train to be one some day - soon!)

7. Make entries in the logbook as appropriate.

4.4 Duties of the PEPII Liaison

We no longer normally have a PEP Liaison, When we do, the role of the Liaison is to serve generally as a liaison between BaBar and PEP-II to increase the overall running efficiency and to minimize the background impact on BaBar. More precisely, they will:

1. Help PEP-II crew to use BaBar inputs and interpret what's going on in BaBar

2. Inform BaBar of what is going on in PEP-II

3. Participate in immediate running decisions (under the authority of BaBar Pilot) with BaBar and PEP-II Pilots.

4. Collect all the information useful for BaBar in PEP-II control room

Note that they are not charged with a specific BaBar protection role. BaBar protection should rely on the BaBar protection system and not on people. However, by having a loving look at BaBar sensors, they will certainly contribute to the overall protection, spotting problems before they become critical.

'Administratively', they are to be considered like another BaBar person on shift, similar to those on shift in the BaBar control room. They therefore report during their shift to the BaBar Shift Leader.

4.5 Record Keeping

1. LOGBOOK. The shift people should ensure that a record of all activities that affect the data are recorded in the electronics logbook. There is both a bound logbook and an electronic one (www.slac.stanford.edu/babar-internal/shift/index). The electronic book is the primary log. The bound log is used as a backup. The link to edit a shift entry is www.slac.stanford.edu/babar-internal/shift/edit?shiftid=nnnn, which works only on IR2 machines.

   In order to optimize ease of communication we need to use the fields in the electronics logbook in a consistent way. The recommended usage is:

   - *Shift takers*: enter the UNIX IDs of the shift people and any people taking training shifts (if they will be present for most of the shift)
   - *General note*: enter the plan at the beginning of the shift and a one or two sentence summary near the end of the shift.
   - *Summary*: Leave this to run coordinator

- *Activities*: The main place to record what is happening. Put everything here that is not recorded elsewhere. Minimally redundant entries may sometimes be helpful to aid readability., e.g. when data taking resumes after an interruption.
- *Problems*: These are BaBar problems, not PEP problems. Be sure to use the hardware remedy form if there is a hardware problem which is not completely resolved (e.g. a bad module was removed), or whose occurrence should appear in the historical record.
- *Beam Conditions*: This is where PEP issues are entered. Much of this is filled out automatically. When the beam is lost, copy the casue from the MCC elog to here. Note that high backgrounds is a *beam condition*, not a *problem*, as are any known detector problems clearly due to high backgrounds.
- *Runs*: Most of this is automatic. After a run has ended, you need to enter the why ended field. If it was not a colliding beam run, you may need to change the run type field.

2. SHIFT SUMMARY. To provide PEP with some information on our use of the delivered luminosity and help the Pilot focus on the efficiency in data taking, the electronics log book has a shift summary section. This is mostly filled out automatically. The Run Coordinator will complete the entries.

3. SHIFT CHECK. Fill out this form once a shift, preferably near the beginning so that problems can be corrected. This is usually done by the Navigator. The purpose of this exercise is more to find and fix problems than to record histories.

Chapter 5

The UNIX farm

The UNIX workstations are organized into several groups each with its intended use.

- Console machines (bbr-conxx): these are used by the shift people to control and monitor the experiment. These machines are located in the console.
- Farm machines (bbr-farmxx): these are used by the event processing and prompt reconstruction processes for data acquisition. These machines are located in racks in and on top of the EH.
- Development machines (bbr-devxx): these are used by non-shift experimenters to monitor the experiment and develop their code. These are located in the control room and on the EH tables.
- Server machines (bbr-srvxx): These file servers are located in the alcove along with the RAID disks and the tape robot.

The UNIX workstations and servers should boot themselves. If there is a problem, contact Steffen Luitz (2822, page 796-2266).

Chapter 6

Operating the DAQ System

6.1 Summary of Pilot's DAQ Duties

Your DAQ Expert:	Pager	Office
Viola Sordini	(650)849 2906	926 2044

For a list of useful supporting documentation, please see this area off the BaBar homepage:
www/Detector/Operations/shifts/DAQDoc/BaBarDAQOperations.html

Half of the duties of the Pilot include the operation of BaBar's Data Acquisition System (DAQ). There are several key steps toward operating the system:

1. **Introduction to the DAQ System**: Section 6.2 is effectively notes on the DAQ Operations Manager's part of the pilot training. It also provides information on the different DAQ consoles, and how to restart the processes running on them.

2. **Know your GUIs**: You will spend most of your time on the DAQ using the Online Run Control (ORC) GUIs – you should spend time before your shifts familiarizing yourself with their layout and features. The GUIs define about 90% of your DAQ working environment, so getting around in your GUIs is a large fraction of your DAQ duty. Section 6.3 of this chapter describes these interfaces.

3. **Know Your Tools**: There may be special circumstances that require the use of commands typed into an xterm or accessed through the GUIs; section 6.4 of this chapter provides you with a list of needs and the tools which meet them.

4. **Know How to Take Data**: 99% of your time will be spent acquiring data, so your most crucial skill is knowing not only how to acquire data but also how to initialize

the system for data-taking. The procedures for this are outlined in section 6.5 of this chapter.

5. **Know How to Calibrate**: Calibrations occur once per day and only when coordinated with beam loss by PEP II; therefore, you should be versed in taking calibrations when the need arises. The procedures for calibration are outlined in section 6.6 of this chapter.
6. **Crib Sheets for What You Forget**: A number of crib sheets which tell you how to take various common types of runs including physics (colliding beam) runs and cosmic runs.
7. **Troubleshoot**: The remainder of your time will be spent troubleshooting any problems or issues which arise. This section has many miscellaneous trouble shooting tips. Known problems and their solutions are outlined on the DAQ webpage, accessible from the BaBar homepage at:

   www/Detector/Operations/shifts/DAQDoc/BaBarDAQTroubleshooting.html
8. **Have Questions?**: If terminology confuses you, look in the glossary for definitions or ask the DAQ expert. You should also look at the DAQ FAQ at the end of this chapter (section 6.9).

6.2 Introduction to the DAQ System

This section is essentially a written version of the training the DAQ Operations Manager gives new pilots. It is meant as concise practical guide to a new pilot; more detailed information can be found elsewhere in the Care and Feeding Manual.

First discussed is an overview of what it is like to be a pilot. Next is the run control system in the context of a tutorial that leads you through taking a run and taking a calibration using a simulated run control environment. Finally discussed are the other DAQ system tools the pilot, organized by the computer screen that on which they appear.

6.2.1 Typical Shift as Pilot

Your duties as pilot are summarized at this link: BF-ROOT/www/Detector/Operations/shifts/shift_instructions.htm#ShiftLeaderDuties.
You typical shift begins with you arriving 15 minutes early and asking the previous pilot shifter if anything went wrong with the system; if something did go wrong then you need to know how to recognize and deal with it. If you have a weekday swing shift then you should also go to the Detector Operations meeting. You need to enter yourself and the DQM into the electronic logbook. Then, you need to read the short term instructions for the day. This all assumes a typical shift; if the shift is atypical, you of course need to use your judgement as to what sorts of things you need to do. For example, on a machine day you would want the previous pilot to tell you who was working on what, and have some idea of the schedule for the day.

If the shift is typical, then there will be beam in the machine when you actually take over as pilot. From here on out, if nothing goes wrong then there is nothing much you need to do except for being attentive. After approximately 45 mins of data taking, PEP will request an injection. (You will know this because a prerecorded voice will say "Injection Requested" and the state machine will go to "Inject/Req".) When this happens, a window will pop up telling you that you should end the run. You may click on "Yes" to end the run immediately, or wait for two minutes after which the run will end automatically. Even if you end the run yourself, the BaBar will already be automatically ramping itself down to allow PEP to injecting more beam. When PEP is done injecting, BaBar will automatically ramp up again. A new run will begin automatically. Really, all that you have to do is make sure that nothing goes wrong. (You do have to perform calibrations from time to time; this will be discussed later.)

When something does go wrong, you will usually be notified either from the alarm handler, or from run control. When a problem does occur, you will either have instructions on how to fix it yourself, or you will page an expert. However, it is important to know how the DAQ system typically behaves and be alert enough to notice when it is behaving atypically. Learning the typical DAQ system behavior is part of the reason shifters must take practice shifts prior to their real one.

6.2.2 Introduction to Run Control (ORC)

You use online run control (ORC) to control data taking. This includes controlling when the data is taken (starting and stopping runs), controlling the source of the data (modifying the crate mask to decide which subsystems to take data from), controlling how data is taken (run control automatically configures the front end electronics of the subsystems depending on which "run type" you choose), and insuring that the data taken is good (component proxies make sure that subsystems are OK to take data at any given time, and ORC is also used to do periodic calibrations.) Generally speaking, you only need to know how to do a few things with ORC.

The following tutorial is intended as a "hands-on" approach to learning about ORC. Section 6.3 has more in depth information about ORC.

ORC Simulation Tutorial

1. On some computer with an X server, ssh to a machine running the basic BaBar setup, i.e. any of the bbr-xxx machines (bbr-devXXX is recommended). Only one simulation may be running on a given machine. Be sure that you have a .shosts file in your home directory and that it has the line "+@ slac-unix" in it. If it does not have this line, add it.

2. Issue the command "/nfs/bbr-srv02/bfdist/Orc/Simulator" (without the quotes) on the command line. It might be easiest to cut and paste from the web version of this document. Only one instance of this program can run on any given machine.

3. Be patient. It can take several minutes for the simulator to finish starting. If there is already a simulator running on your machine then you will quickly get a message telling you so.

4. Eventually, you should get the main run control GUI as shown in figure 6.1. The real ORC will look identical when first started. In fact, from here on out unless otherwise stated, the simulation looks identical to the real thing.

5. The main GUI shown in figure 6.1 has three sections as follows:

   - The **main control** section is shown outlined in red.
   - The **subsystems** section is shown outlined in green.
   - The **proxies** section is shown outlined in blue. The proxies section is subdivided into critical and non-critical proxies.

6. The **main control** section is divided into two parts, upper and lower. The upper part is used for Run Control and state display. The lower part displays the run number, run duration and xtc file size as the run progresses. The run number is undefined at this point in the simulation.

7. To begin, press the yellow "Click to select Run Type" button. A drop down menu shows the available run types. This is shown in Figure 6.2. Run types specify the way in which data is taken from the detector. They determine the default systems to take data from, the trigger lines to use, and the configurations to be given to the DAQ crates and front end electronics. There are four run types that you are likely to encouter as shifter: the "PHYSICS" run type is used to take collision data, the "COSMICS" run type is used to take cosmic data, the "COSMICS_L1PASSTHRU" is used to take cosmic data with an indiscriminant Level 3 trigger, and "DAQTESTS", which are occasionally used by the pilot to verify that the DAQ system is working after a long down time.

8. For the purposes of this tutorial, select the "PHYSICS" run type. ORC then briefly moves to a "BUSY" state as shown in Figure 6.3 after which the "PHYSICS" run type is set and ORC is then in a "STANDBY" state. This is shown in Figure 6.4. At this point, the shifter has two options as indicated by the blue "CALIBRATE" and "BEGIN" buttons. These will be discussed later.

9. Figure 6.5 shows the **subsystem** and **proxies** parts of the display, several parts of which are described below:

   - Circled in green are three sets of crate mask buttons. The crate mask determines which subsystems that we take data from. (Compare this with the function of the component proxies discussed next). You can change whether a subsystem is included by clicking on the buttons circled in green. If data is not taken from a subsystem then by default its component proxies are not runnable either.
   - Circled in blue are the component proxies. If we decide to take data from a system, the SVT say, then we want to make sure that the data from that system is good. For example, if the high voltage of the SVT is not ramped up then the data we get from it will be garbage. The SVT component proxy will watch the SVT high voltage. If it ramps down, then the proxy will go red and "not runnable" and the run will automatically pause until the proxy says that the

SVT is OK to take data from, or runnable, again. By clicking on the SVT proxy status display, the status will go to “Ignored” and ORC will not care whether it says the SVT is runnable or not. Note that whether to ignore the SVT proxy is a completely distinct decision from that of whether to take data from the SVT at all. Certainly, if we are not taking data from the SVT then we should not care whether its data would be good if we were taking data from it, and for this reason ORC automatically ignores the SVT proxy when we take the SVT out of the crate mask. Nonetheless, after taking the SVT out of the crate mask we can still respect the SVT proxy by clicking on its display.

- Circled in red are the ORC proxies. They look after the health of various bits of software that ORC needs running to function properly. The DFDISPLAYEPICS and DHPODFDSIAPLAY proxies may show a 'NOT THERE' status both in IR-2 and in this simulation. They have been built into ORC in advance since they will activated in the near future. Other than these two proxies, all proxy displays in IR-2 should be green or blue. Unfortunately, the OEPMANAGER, DHP_COLLECTOR and DAQCRATEMON are not simulated yet, so their displays are red in the simulation.

10. For now, we will not mess with the crate mask or with which component proxies ORC is not ignoring. From the main control section, select 'BEGIN'. After a few moments, your screen should look like Figure 6.6. If you are on shift and want to take physics data, that is all you must do: select the run type and begin the run. Its is at this point that the run number is allocated. In the simulation it is set to 10000. If you let the run continue you will see that the run duration and the XTC file size is also monitored.

11. Once the run has begun, the shifter has two options which are “END” and “STANDBY”, both of which will end the current run. However “STANDBY” will take you to the STANDBY state from which you can perform a calibration or change the run type. Selecting “END” will just end the run and take you to the CONFIGURED state as shown in Figure 6.7. This will allow you to take another run with the same conditions or to proceed to the STANDBY state (by selecting the “STANDBY” button).

12. The run will not begin until we have stable beams and BaBar is ramped up, and afterwards the run will automatically start and stop as needed. Note that when ORC wants to end a run do to a top-off or a beam loss, it will ask you if this is OK via a window that pops up and recommends that the current run be ended; if you do not respond to this window for 2 minutes the run will end automatically.

13. Sometimes the pilot needs to pause the the run manually. To do this, click on “Control+“ on the toolbar, and then select “PAUSE“. ORC then moves from its RUNNING state to a PAUSED state. You may resume the run by clicking on “Control+“, and then selecting “RESUME“. ORC then moves back to its RUNNING state.

14. You may experiment with ignoring one of the component proxies. Choose to ignore, say, the SVT component proxy (see figure 6.8.) Begin the run again by selecting

"BEGIN" from the main control menu. If you were actually taking data and the SVT ramped down for some bizarre reason, say, then ORC would continue to take data from it and for all practical purposes ruin the run. On the other hand, if the DCH were to ramp down then ORC would automatically pause the run because the DCH proxy, which ORC is not ignoring, would see that the DCH was no longer able to take good data. When the DCH ramped up again, the ORC would resume the run.

15. Now, restart the Dataflow proxy while your simulated ORC is still taking a run. (You would NEVER want to do this with the real ORC.) Click on the dataflow name, and select "Restart Proxy". A window will pop up confirming you wish to restart the proxy as shown in Figure 6.9. Click on "OK". Another window will pop up telling you that the dataflow proxy is killed. When this has happened ORC will go to an ERROR state. Another window then appears (shown in figure 6.10) telling you that ORC has detected an error. Click on "Clear". Soon after, the dataflow proxy should be alive again. In general when ORC runs into a problem, it will go to an ERROR state. If you were working on the real ORC, then an error message would appear on the ORC CMLOG with a few more details about the error. Whenever ORC does go to an error state, select "Clear" from the popup window. This causes ORC to go to its STANDBY state.

16. Once in STANDBY state you could begin another run. Instead, lets do the ORC side of a global calibration. Let us discuss for a moment what you would do now if you were really on shift. Global calibrations are only done with no beam. You would look at the time of the last calibration; if about 48 hours had passed, you would call MCC and tell them that you would like to perform a global calibration. Assuming they say this is OK, you would then put the state machine into manual mode and deny injection requests.

17. Click the "Calibrate" button. The run type does not to be set for you to to do this. A central calibration GUI will appear in front of the main control GUI. The user will be unable (and should not need to) access the main control GUI while performing a calibration.

18. Select "CALIBRATE" from the central calibration GUI. If you were really on shift then the IFR, SVT, DCH and DRC would ramp automatically on calibration. The simulator is configured to take roughly the same amount of time to calibrate as the real thing does. All subsytems except the EMT will automatically be selected for calibration and the EMT will automatically calibrate after the EMC calibration has finished.

19. When the calibration is done, "FINISHED_OK" will appear under each successful subsystem name and "FAILED" will appear under the failed subsytem names. In the simulator, you should usually only see "FINISHED_OK", but sometimes you can get "FAILED" due to timing problems between the various processes. (See figure 6.11, which shows three subsystems succeeding and three failing.) If a calibration fails, try clearing it and calibrating again. This can be done for a single detector using a pull down menu you get by clicking on the subsystem name just above the "FAILED"

message. Dismiss the calibration GUI by clicking the "Dismiss" button in the top left corner of the GUI window and select OK from the pop-up confirmation window. A cleanup process will automatically run where the central calibration GUI is *replaced* by the main control GUI.

20. If you were on shift, then you would put the state machine back into automatic mode and then permit injection requests.

21. The toolbar at the top of the main control section on the main control GUI has six options. These are "File", "Control+", "Settings", "Expert", "View" and "Help". The "Control+", "Expert" and "View" options are discussed in section 6.3.3.

    - **File**:To quit the simulator, select "Exit" from the File menu at the top left of the main control window. A cleanup script will run automatically. When taking data, "Exit" only be used in a real emergency. The "Close ORC GUI" option only kills the GUI (and may leave other processes running in the background).
    - **Settings**: Figure 6.12 shows the popup window which should appear when the pliot clicks on the "Settings" button. This panel allows the pilot to change the values of the "crate mask", "trigger mask", "Run Time Limit" and "XTC File Size Limit". For each of these parameters there are two fields - these are the "Current Value" and the requested "New Value". When required, the new value can be typed into this field. ORC will inhibit typing when it is undesirable and indicate this by greying the field out. Only when instructed to do so should the pilot alter the trigger mask. The *Factory Mode* option ensures that a number of Run Control processes are run automatically, such as suggesting to end a run. In normal running, Run Control should be in Factory Mode. This is indicated by the green square next to the words "Factory Mode". Only run out of Factory Mode (grey square instead of green) if SPECIFICALLY advised by an expert. In general, all of these options should not be changed under routine running conditions.
    - **Help**: Clicking on the "Help" button displays a notice which reminds the pilot that right clicking on most of the buttons will pop-up a short description of their functionality.

6.2.3 Overview of Your Consoles

Most of your work as pilot will be done on the phone, or on one of seven console machines located in the large 21-screen structure in the corner of IR2. There are seven of them named: bbr-con01, bbr-con2, bfo-con03, bfo-con04, bfo-con05, bfo-con06 and bfo-con07. (See figure 6.13) Machines bbr-con01 and bfo-con03 have two monitors. All other machines have three monitors. A machine's monitors are all stacked on each other vertically; for example, bfo-con03's two monitors show main run control and the run control CMLOG.

Each machine will be discussed in further detail. The following is a summary of the function of each screen as it is shown in figure 6.13:

- VESDA Alarm: Not an IR2 consoles computer display.

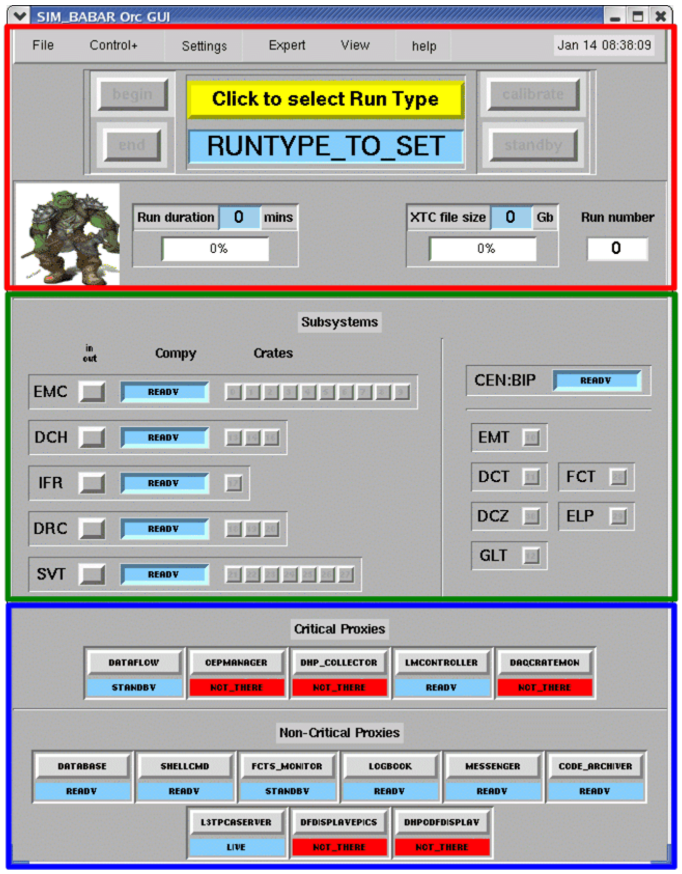


Figure 6.1: The ORC Simulator has just started. The main control, subsystems and proxies section are outlined in red, green and blue respectively.

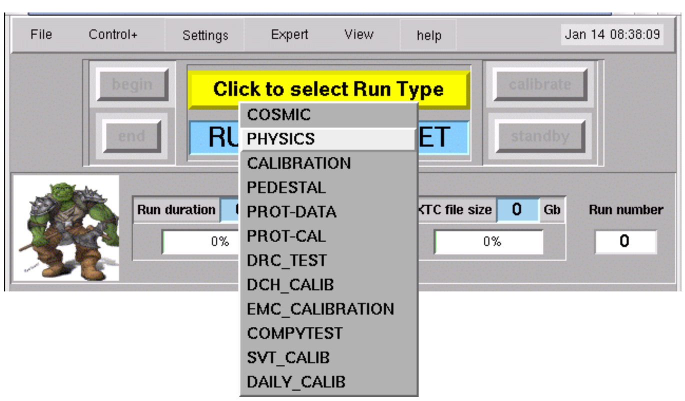


Figure 6.2: The run type is selected by clicking on the yellow button and selecting from the drop down menu.

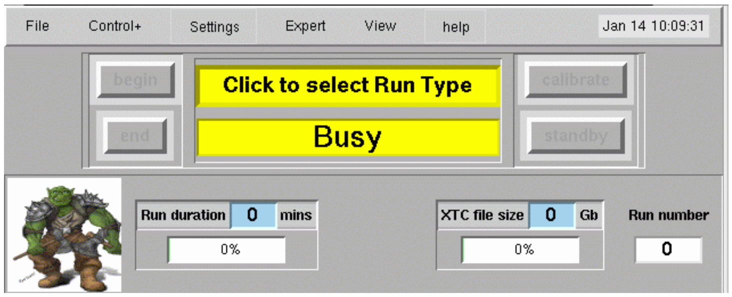


Figure 6.3: ORC moves to a BUSY state just after the run type is selected.

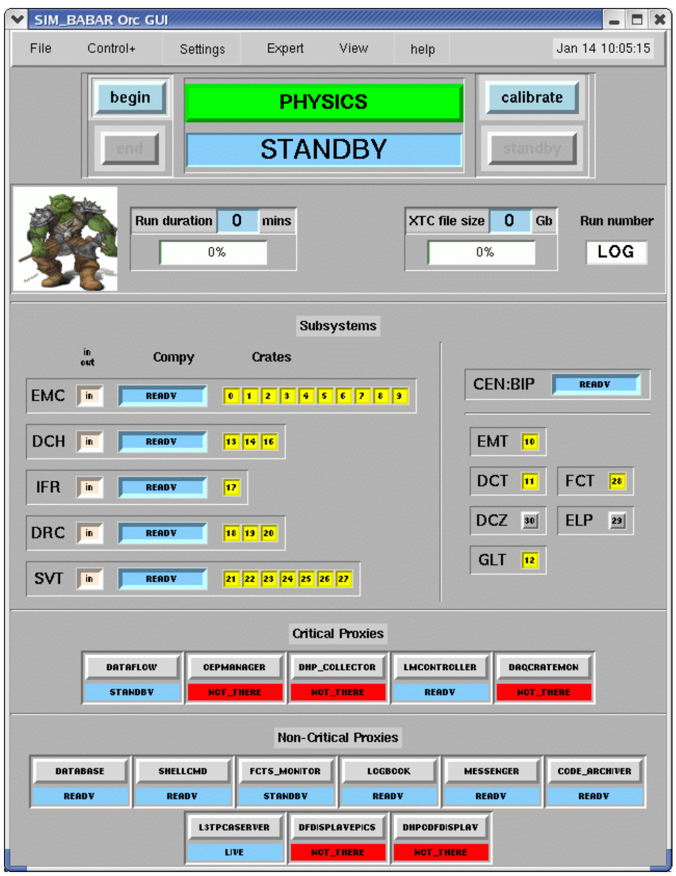


Figure 6.4: The "PHYSICS" run type has been set and ORC is in a STANDBY state..

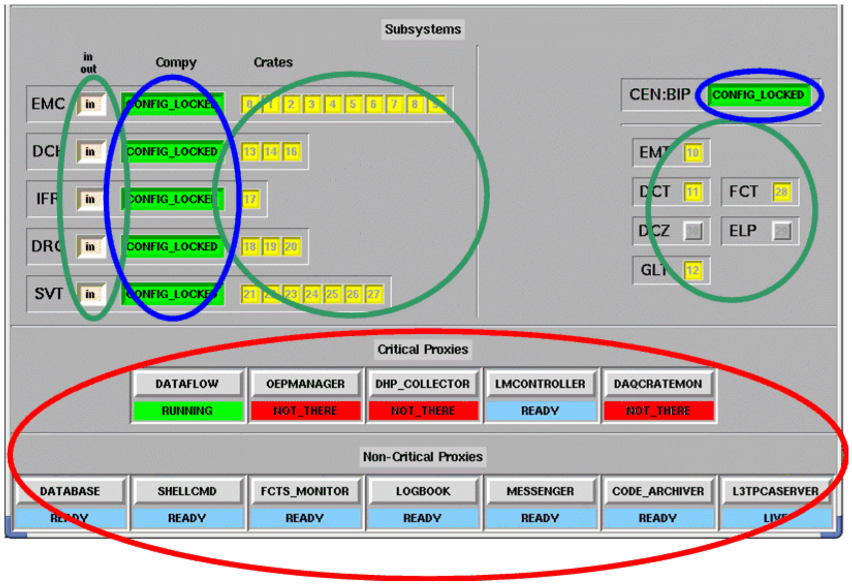


Figure 6.5: The three sets of crate masks are circled in green. The component proxies are circled in blue and the ORC critical and non-critical proxies are circled in red.

- Alarm Hand: Shows the alarm handler.
- EPICS: Shows a bunch of epics panels, plus strip charts identical to those shown in bbr-con02's top display.
- Prime Strip Charts: Strip charts detailing how a variety of background and DAQ information change over time.
- State Mach/PEP Status: Where the pilot sees the status of PEP, and can control the state machine.
- Log book: Where the pilot edits the electronic log book.
- TV: Not an IR2 consoles computer display
- ORC CMLog: The CMLOG browser that shows run control errors.
- ORC Main Control: Where the pilot controls the run control system.
- Log Man./FCTS: Shows a variety of information about the current run plus level 1 trigger information.
- L3T Out Display: Shows events as they are seen leaving the level 3 trigger.
- L3T Rates: Shows information about level 3 trigger input and output rates.
- OEP Man.: Shows the status of the level 3 farm nodes.

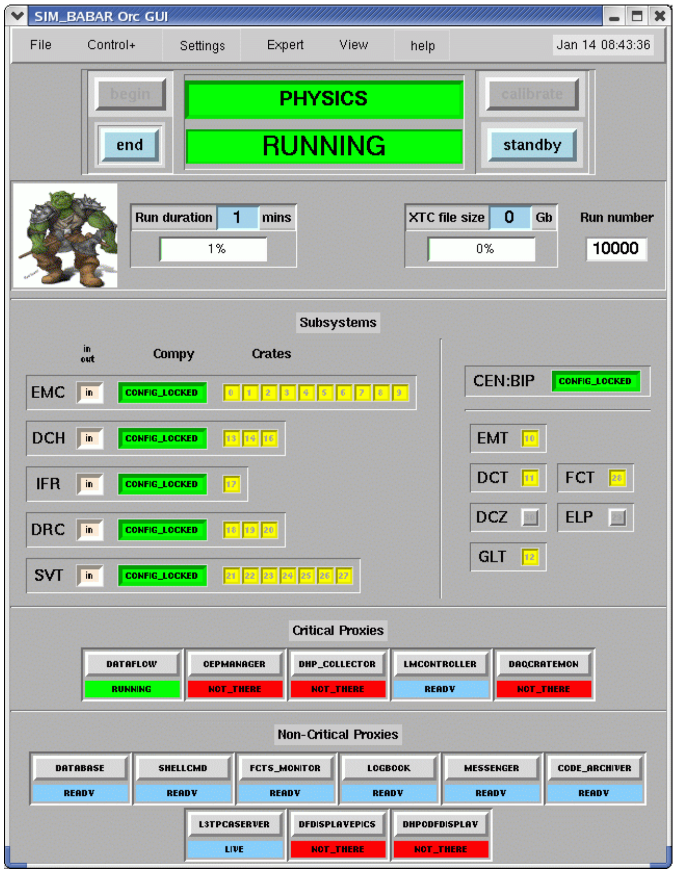


Figure 6.6: PHYSICS data is now being recorded. The run number has been allocated and the run duration and XTC file size are also monitored.

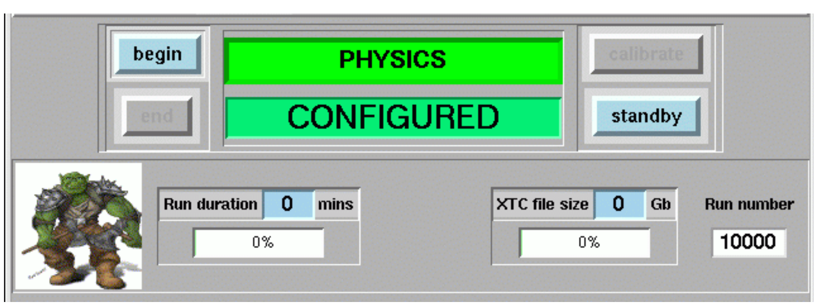


Figure 6.7: ORC is now in a CONFIGURED State. The pilot is able to begin (BEGIN) a new run or return ORC to STANDBY.

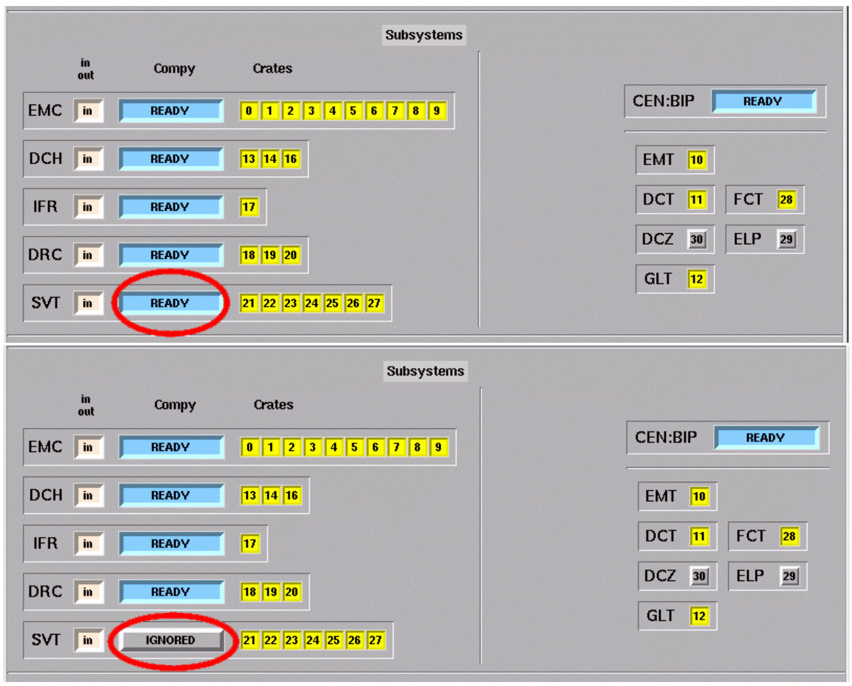


Figure 6.8: You can ignore the SVT component proxy by clicking in its proxy display, outlined here in red (top.) When a proxy is ignored, its display will be grey and display the words “Ignored”(bottom).

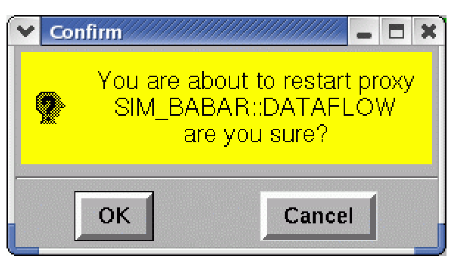


Figure 6.9: The user is prompted to confirm whether they wish to restart the dataflow proxy.

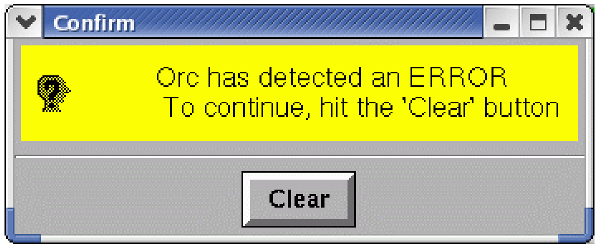


Figure 6.10: The user is prompted to clear an ERROR detected by ORC.

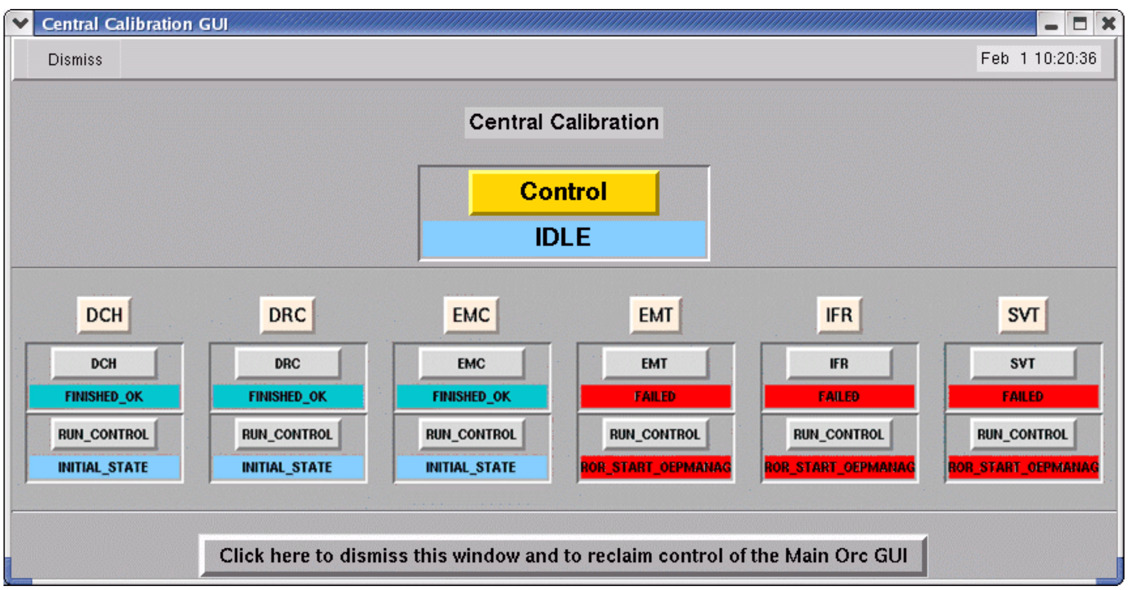


Figure 6.11: The simulated calibration has finished. Notice the words "FINISHED_OK" in blue beneath the name of each successful subsystem. For the subsystems that failed this area reads "FAILED" and is red.

Figure 6.12: During normal PHYSICS data-taking, the pilot should not need to change any of the settings, unless specifically instructed otherwise.

- L3T In Display: Shows events as they are seen entering the level 3 trigger.
- Fast Mon CMLog: A DQM display, the CMLOG for fast monitoring.
- JAS/Fast Mon Control: A DQM display, shows JAS and fast monitoring control.
- Bkgrd Strip Charts: Shows how many different levels of background change with time.
- Bkgrd Display: Displays a summary of background all over the detector.
- WIRED: The WIRED display shows what the detector is seeing in real time.

6.2.4 Logging into the Consoles

You should not restart a console yourself. If a console hangs, page computing any time of day or night. (How to page computing will be explained shortly.)

6.2.5 bbr-con01: Introduction to EPICS and the Alarm Handler

Machine bbr-con01's displays show the alarm handler and a variety of epics panels. More information about how to use EPICS and the alarm handler can be found in chapter 7.

Restarting EPICS and the Alarm Handler

You can restart both EPICS and the alarm handler by pressing the yellow button at the bottom of the bottom screen (see figure 6.14.) Note that because the epics strip charts will loose their history if you restart them, a dialog box will pop up for each chart and

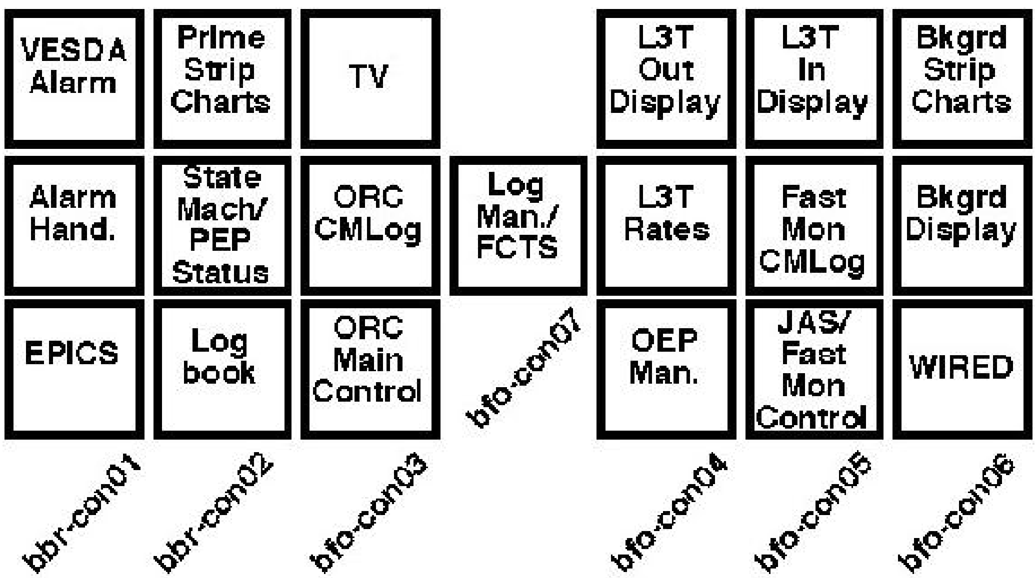


Figure 6.13: The layout of the IR2 console machines' displays, plus for completeness the VESDA alarm panel and the TV that sits above bfo-con03. There are seven IR2 console machines with names bbr-con01, bbr-con02, bfo-con03, bfo-con04, bfo-con04, bfo-con05, bfo-con06 and bfo-con07. Each machine's monitors are stacked vertically so that for example: bbr-con01 has the screens labeled here as "EPICS" and "Alarm Hand." (the VESDA alarm panel is not a computer display); bbr-con02 has screens labeled here as "Log book", "State Mach/PEP Status", "Prime Strip Charts"; etc.

ask you if you want it to be restarted (see figure 6.15.) After you press the buttons, bbr-con01's top display will look like the top screen shot in figure 6.16. You must press the "Main" Alarm Handler button outlined in green, and the CMLOG "OK" button outlined in red. Next, look at the "Update" menu item frop the "Options" menu in CMLOG as outlined in red in the middle screenshot of figure 6.16. If there is no red square next to the word "Update" (there is none in this screenshot) then select it. A window will pop up automatically and is shown in the bottom screenshot of figure 6.16. Click its "OK" button which is outlined in red.

The Epics Panels

As a new pilot, there are only two main EPICS panels that you must know about (except for those on other IR2 screens.) If you look on the top left virtual screen on the bbr-con01 bottom screen, you will see the background EPICS panel (see figure 6.17.) It gives information on the background that BaBar is seeing. A new pilot needs to be most concerned with the SVT diode readings, circled in red in the top screenshot. There is a software abort system that keeps track of these diodes. When any diode except for the backward west diode, which can give faulty readings, sees background that is considered high, its display turns yellow or red and a timer is started. If the background stays high for ten minutes then the beams are dumped. Obviously, this is a bad thing, and as pilot you need to notice if this countdown starts. To see the status of the countdown, you can click on the "Abort Status" button, circled here in blue. This will bring up the panel shown in the bottom screenshot. Circled in blue is the number of minutes the background has been considered high. If this number gets to ten, then the beams will be dumped. If there is a liaison on duty, then you can call the liaison whenever this countdown starts. If there is no liaison on duty, you must use your judgement as to whether to call the MCC operator, who is probably already aware that backgrounds are high and is trying to lower them. Certainly, if the timer is up to six or seven minutes (i.e. only three or four minutes until beams are aborted) then you should probably call MCC.

The Alarm Handler

The alarm handler is the primary means by which you will be alerted to problems with BaBar. A problem will cause the alarm handler to start to beep to alert you that there is a problem. General speaking, disconnected systems cause the alarm handler to blink white, major alarms cause the alarm handler to blink red, warnings cause the alarm handler to blink yellow, and systems returning to normal cause the alarm handler to blink green. In IR2 in general, in fact, white means some system has disconnected or is giving nonsensical output, read means a major alarm, yellow means a warning, and green means all OK. If you see, for example, an epics panel that is white then this is cause for concern. More information on the types of alarms in in section 7.2.4.

You can find information on how to navigate the alarm handler in section 7.2.3. The caption in figure 6.18 also has information. In general, you need only remember: white,red = bad; yellow = warning; and when in doubt click the "P" and "G" buttons (see section 7.2.3) or failing that page the subsystem.

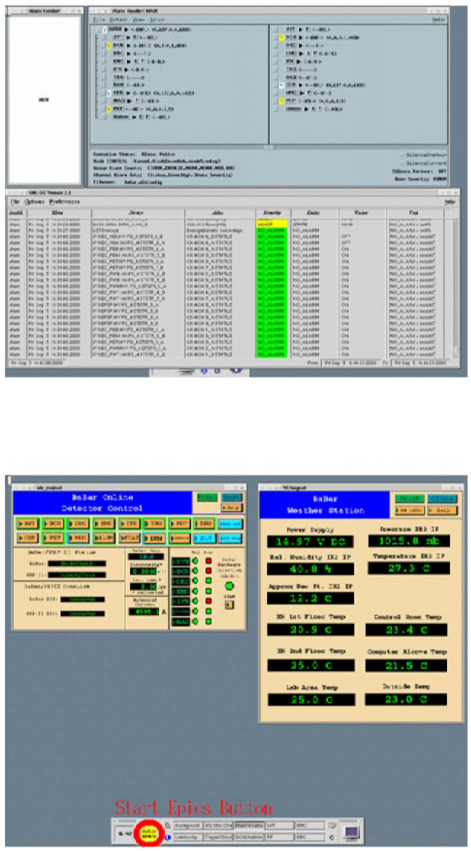


Figure 6.14: The displays of bbr-con01. Restart EPICS and the alarm handler by pressing the button outlined in red above. For more information on EPICS or the alarm handler, see chapter 7.

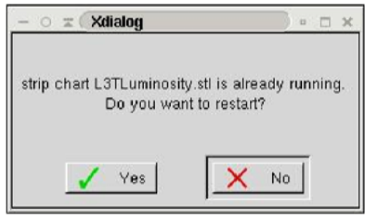


Figure 6.15: Whenever you press a button that tells a console's EPICS panels to restart, for each open strip chart you will be prompted as to whether you want it restarted. Usually, you should say no.

6.2.6 bbr-con02: The Primary Strip Charts, the PEP-II Status and State Machine EPICS Panels, and the Pilot Web Browser:

This machine's displays show: strip charts that show how background and a variety of information about the DAQ system change with time; the PEP-II status, BaBar state machine, and time-since-last-SVT-Abort-Calibration EPICS panels; an xterm that displays the times each subsystem was last successfully calibrated; a utility called bbStat which allows you to easily copy and paste beam info into the logbook when there is no liaison on shift;and the web pages with which you can page experts and edit the electronic logbook (see figure 6.19.) There is also a blue button which lets you take a screen shot of every virtual screen of every physical display of every BaBar console machine (this button can also be seen in figure 6.19.)

Restarting the Processes of bbr-con02

You restart them, plus the SVT-Abort-Calibration panel and calibration times xterm, with the "Start Epics" buttons outlined in green. (For each strip chart, you will be prompted as to whether you wish it restarted (see figure 6.15.) You restart bbStat with the "bbStat" button outlined in red. You can take the console screen shots with the "Screen Shot" button outlined in green. You can restart any web page browsers that have been closed by pressing the "WEB" button outlined in red.

The Web Pages

As pilot, there are several web pages that you should know about. Most of them are automatically loaded on the bottom screen of bbr-con02. Pilot reference material is at the link BFROOT/www/Detector/Operations/shifts/shift_page_template.htm. Before every shift you should read the "Important short-term Operational and DAQ shift information for pilots" link, also called the "Short Term Instructions" link, The "Shift Leader Concise Manual" links to a very brief set of instructions for the pilot. The concise manual also

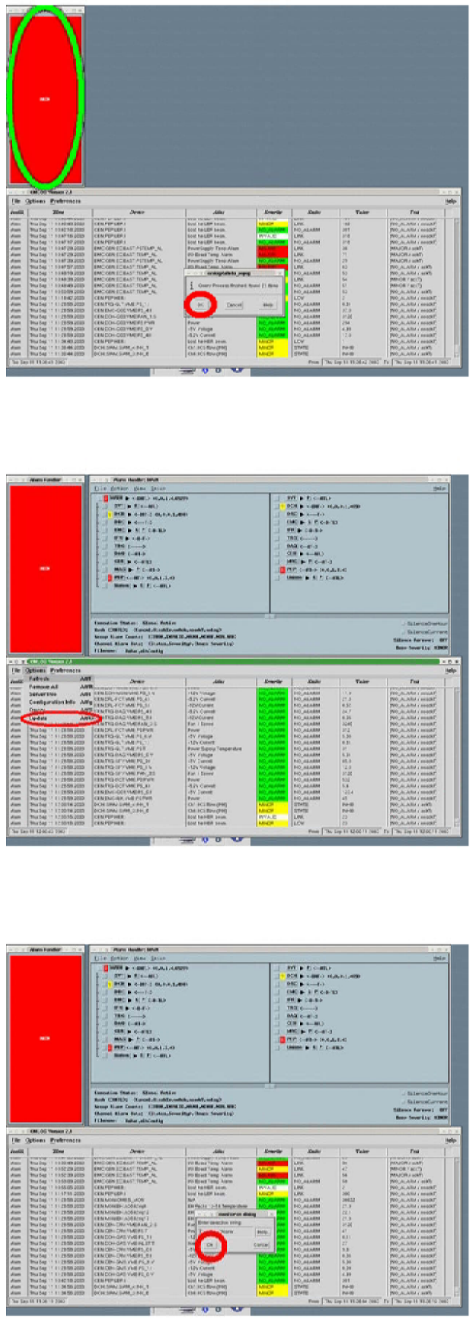
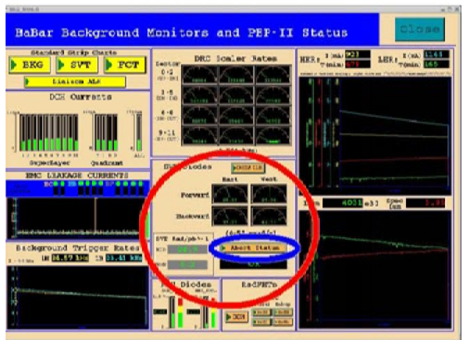


Figure 6.16: After pressing the EPICS button shown in figure 6.14 and answering the dialogs like those in figure 6.15 you must still perform a few mouse clicks. Press the “Main” Alarm Handler button shown circled in green in the top screen. Also, click the ”OK” button outlined in red in the top screen. Next, look at the ”Update” menu item frop the ”Options” menu in CMLOG as outlined in red in the middle screenshot. If there is no red square next to the word ”Update” (there is none in this screenshot) then select it. A window will pop up automatically and is shown in the bottom screenshot. Click its ”OK” button which is outlined in red here.



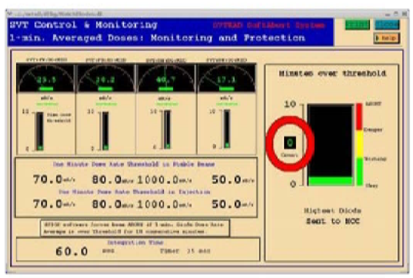


Figure 6.17: This EPICS panel gives information on the background that BaBar is seeing. A new pilot needs to be most concerned with the SVT diode readings, circled here in red in the top screenshot. There is a software abort system that keeps track of these diodes. When any diode except for the backward west diode, which can give faulty readings, sees background that is considered high, its display turns yellow or red and a timer is started. If the background stays high for ten minutes then the beams are dumped. Obviously, this is a bad thing, and as pilot you need to notice if this countdown starts. To see the status of the countdown, you can click on the “Abort Status” button, circled here in blue. This will bring up the panel shown in the bottom screenshot. Circled in blue is the number of minutes the background has been considered high. If this number gets to ten, then the beams will be dumped. If there is a liaison on duty, then you can call the liaison whenever this countdown starts. If there is no liaison on duty, you must use your judgement as to whether to call the MCC operator, who is probably already aware that backgrounds are high and is trying to lower them. Certainly, if the timer is up to six or seven minutes (i.e. only three or four minutes until beams are aborted) then you should probably call MCC.

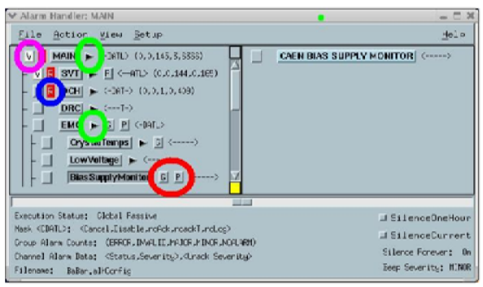


Figure 6.18: The main window from the alarm handler. For instructions on how to navigate the alarm handler, see section 7.2.3. To clear all transient alarms and stop the alarm handler from beeping, you can click on the box circled in purple (which in this case is showing a white alarm, indicating something in the SVT has been disconnected.) You can follow any errors by clicking on the arrows, circled in green. When you find that error, there may be up to two buttons for you to click on for more information, circled in red. The “G” button gives you advice on how to handler that type of alarm, and the “P” button will open up either a web page or an EPICS page relevant to the alarm. Note that for this screenshot, the errors were actually with the SVT and DCH, not the EMC which has been expanded for demonstration purposes.

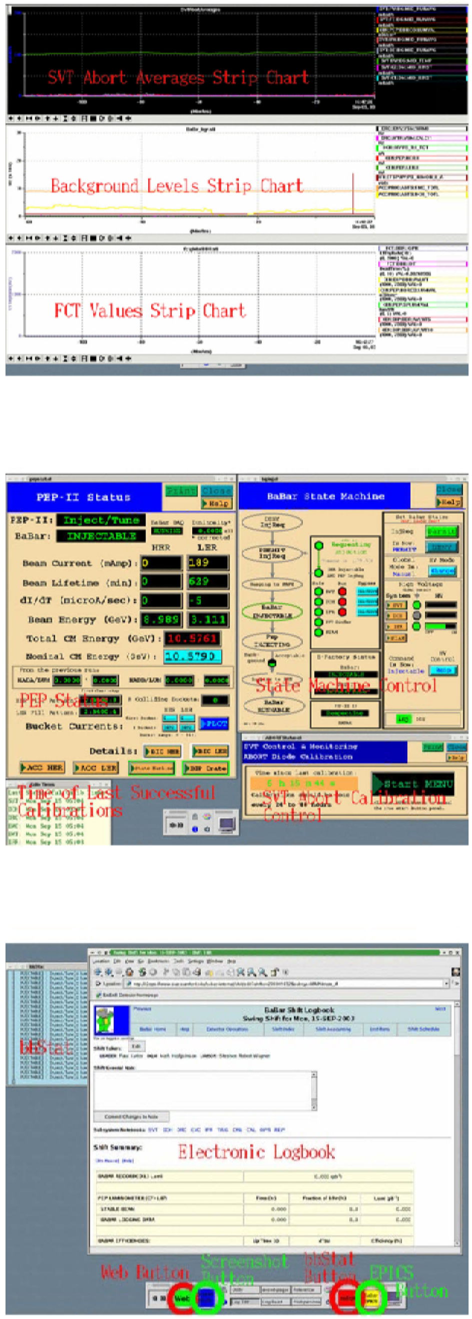


Figure 6.19: To restart the strip charts and the EPICS panels, press the EPICS button outlined in red above. Since the strip charts loose their history when restarted, you will be asked for each strip chart if you want it restarted. To reload any web pages that have been closed, press the web button outlined in red above. To restart bbStat press the “bbStat” button outlined in red. To take a screenshot of every virtual screen of every physical display of every console machine, press the “Screenshot” button outlined in green.

has list of pilot duties. These are also linked to from the "Shift Leader Duties" link. The "Taking Data and Running the State Machine" link points to a description of the state machine. The "Resetting DCH High Voltage trips" points to some instructions describing what a DCH trip is and how to deal with one. The "How to Operate the DAQ system" link points to a collection of instructions on how to do some common tasks with ORC, such as take a calibration or get ready to take collision data. This information is also in the Care and Feeding Manual. Finally, the "How to troubleshoot the DAQ system" link points to descriptions of a number of DAQ problems and how to deal with them. You should try to be familiar with what problems are listed (not neccessarily their solutions).

Pressing the "Web" button also brings up a page pointing to the electronic logbook page for the current shift. As pilot, you must enter a variety of information here. At the beginning of the shift, you must enter the unix IDs of you and of your DQM. If there is, say, more than one DQM because someone is on taking a training shift, then just separate the unix IDs by a comma. There is a "Shift General Note" where you can enter a general description of the entire shift. If there is a machine development day during your shift, for example, then you want to put that information here, together with a rough schedule. Any work done should be recored in the "Activities" section. Any problems should be recorded in the "Problems" section. If there is no liaison then you must also enter information into the "Beam Conditions" section. Whenever a beam topoff is began or completed, the beam conditions are automatically copied into the logbook. However, if the beam is aborted by BaBar, then you must record this information manually; be sure to include which SVT diode(s) was (were) responsible for the abort.

You can get a good sense of how much information you should put in the logbook by looking at previous shifts. In general, you cannot record too much information. One thing that you do not need to do is record CMLOG information verbatim; this information is logged and can be easily retrieved by an expert who knows at what time it occured.

The IR2ContactDB form is also on this screen which you should use to page an expert should a problem arise. If an expert does not call back within ten minutes or so, then you should call his/her cell phone and page him/her manually. When you page manually, call the pager number, and enter "5255#". Be sure to remember the pound sign. If the expert does not call back within another ten minutes, call the backup expert.

Introduction to the State Machine

The BaBar State Machine is described, succinctly in section 8.2. As a new pilot, you should be sure to remember the following: first, as pilot you can only use the state machine to manually allow or disallow injection requests, not the injections themselves, so you need not worry about hurting the detector; second, to take data the state machine should allow injection requests and be in automatic mode, and the SVT, DCH and IFR should all be in global mode; and third, if MCC stops injecting and a new run does not start for some reason, the state machine should be one of the first places you look as the subsystems will not ramp up if the background is too high.

The PEP EPICS panel gives beam information including the HER and LER currents, beam lifetimes, etc. This panel also gives the status of the beams, that is, whether MCC is requesting an injection, injecting, or has declared stable beams. As pilot you should always be aware of whether PEP is injecting or not, and of whether we have lost the beams. This is not too difficult as there are voice recordings that let you know when these things happen.

Below the the state manager EPICS panel is a window that gives the times that each subsystem was last successfully calibrated. Instructions for how to calibrate are in the ORC tutorial. In general, ORC should be calibrated about every two days.

Introduction to the Strip Charts

The strip charts on the top screen of bbr-con02 show you how a variety of values have changed over time. As a shifter, you especially need to worry about the dead time (shown in pink on the bottom strip chart) and the L1 trigger rate (shown in blue on the bottom strip chart.) See section 6.2.7 for more information on dead time. The L1 trigger rate is a good measure of change in background, as it will spike if background spikes. You can also look at the SVT diode readings in the top chart to get an idea of how background changes.

6.2.7 A Note on Dead Time

Dead time is the percent time that the DAQ system is not collecting data. Assuming there is data to be had during this time, this is a bad thing. Typically, BaBar runs with about 0.6% dead time. You will first be alerted to unusually high dead time by the alarm handler. You can also see the deadtime by looking at the display of bfo-con07.

If you do see unusally high deadtime, you must try to find its cause. There is no exact recipe to do this; it just takes experience and a feel for the system as a whole. As far as the shifter is concerned, dead time can generally come from one of two sources: high background or a (often quite serious) problem in the DAQ system. Luckily, as a new shifter your first shifts will be day shifts, and you can always page/call the DAQ Ops manager or dataflow if you get confused.

If the deadtime is due to background, then you should see high background as well as high deadtime. Just what constitutes high background changes, and you must have spent some time in IR2 to know what the typical level of background has been lately. (This is one of the reasons to take one training shift if you have not been a pilot shifter lately, and two training shifts if you have never been pilot shifter.) A good indicator of high background is a high L1 trigger rate; again, you must know the typical L1 trigger rate, which changes with time, to know a high L1 trigger rate. If you have a sudden spike in deadtime, then it is usually fairly easy to correlate this with a spike in the L1 trigger rate.

If the deadtime is due to high background, then ideally you can call the PEPII operator who, after hearing about the high background, will reduced it. Of course, practially speaking, you must use your own judgement. For example, if the topoff has just been completed, then the operator probably knows that background is too high, and is trying to reduce it, and a call from you would just be an unneccesary distraction (but not the end of the world.) On the other hand, if the topoff was completed 10 minutes ago, and we are still at 10% deadtime due to background, then you should give the operator a call.

If the deadtime is not due to background, then there is a problem somewhere in the DAQ system. You should call dataflow so that they can investigate it. As for anything in the DAQ system, if you are unsure as to whether you should page dataflow, you can page the DAQ Ops manager first.

6.2.8 bfo-con03: The Run Control Console, Run Control CMLOG and OEP Manager

From this machine's bottom display, you will operate Run Control, use commands in orcXterms, and monitor the health of the DAQ system.

From this machine's top display, you will monitor transitions within the DAQ system. The CMLog displays the output from variables aspects of the DAQ system (ODF, OEP, ORC, etc.), and should be used frequently to check for non-routine error messages. If a failure in ORC occurs, this is the place to look for more information.

Restarting ORC

To restart ORC or the ORC CMLOG if either is not already running, you can press the ORC icon outlined in red in figure 6.21. (If both ORC and the ORC CMLOG are already running then pressing the button does nothing.) For information on how to kill ORC, see section 6.3.3.

The orcXterm

The ORC xterm is the terminal from which you should issue all commands which relate to the DAQ system. It is labeled in figure 6.21. It should be created automatically when you press the button to start ORC. You can start it manually by typing (at bfo-con03):

```
orcXterm
```

The orcXterm is a shell on bbr-srv03, where all of the ORC processes run. That is why it is important to issue ORC-related commands from this special xterm.

Starting Orc from the Command Line

The easiest way to start ORC is to press the Orc Icon. If that does not work, you can always start ORC by typing the following in the orcXterm:

```
runOrc
```

This brings up the state managers for each proxy and checks that the proxies are running, then brings up run control. This can take several minutes.

The Production Area

Within the orcXterm, you should execute commands from the Production area on NFS. By default this is where the orcXterm places you, but if you wander from it you can always return by typing:

```
production
```

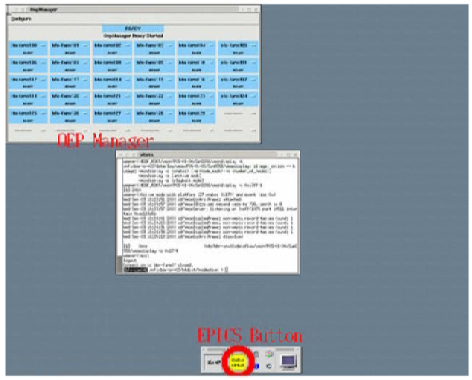


Figure 6.20: The OEP Manager GUI.

Introduction to the OEP Manager

Figure 6.20 is the OEP Manager GUI which shows the status of the unix farm nodes that run the L3 trigger processes. You can also use this GUI to start and stop individual farm node processes, view their logfiles, and configure some variables that control the overall use of the farm node processes. For more information, see section 6.3.7. The OEP Manager may only be restarted from within ORC.

Restarting the OEP Manager

The OEP manager must be restarted in ORC by restarting the OEP manager proxy. You do this just like restart any other ORC proxy: left-click on its name, and select "Restart" from the menu that pops up. When it is starting up again, be sure to give it time to connect to all of the L3 nodes before you initialize ORC. Typically you should not be restarting the OEP manager.

ORC may lose communication with a farm node during normal data taking, although this has become very rare. If ORC does lose contact with a L3 node then the DAQ system should recognize that it has lost a node and stop sending events to it. At that point the triggers will resume. You will see a message on the CMLOG saying "Event level node NN trimmed", so you can identify the culprit. You may continue taking data and there is no need to end the run. When the next run begins, ORC should automatically resume contact with the lost L3 node.

However sometimes after a L3 node has been trimmed, the OEPMANAGER proxy will report an error at the end of the run. This error may cause ORC to enter an error state, which can be cleared by selecting CLEAR and starting the next run as normal.

The CMLOG

CMLog is a client which connects to the CMLog server and displays messages which are relayed by the ORC system to the server. Normally, if CMLOG is not already running it can be started by pressing the ORC icon. It can also be started by typing into a bfo-con03 xterm (NOT the green ORC xterm):

```
startcmlog
```

This will bring up the CMLog on console bfo-con03:0.1.

Sometimes if the server that runs CMLog (which should not require any pilot interaction) stops (either intentionally because of maintenance, or untentionally because it crashes), then both the Alarm Handler and CMLog browsers will disconnect.

If the server then restarts then a pop-up window will appear that will give a server disconnected error. When this happens you can do one of two things. You can either exit and then restart the CMLog window. Alternatively, once the server has restarted you can click on the **File** menu in CMLog and select **CONNECT**. Then click on the **Options** menu and select **UPDATE**.

Messages will display in the CMLog every time transitions occur in Run Control.

6.2.9 bfo-con07: The Logging Manager and FCTS EPICS Panels

The Logging Manager Statistics EPICS panel provides global information about the current run and can be used to diagnose global problems with a run (large event sizes, trimmed farm nodes, deadtimes, etc.) Most of the important entries are fairly self explanatory, for example: the run number, Logging Manager rate, XTC file size, and event sizes.

The FCTS most importantly displays the L1 trigger rate, the L3 trigger in and L3 trigger out rates, and the deadtime. The deadtime graph is actually three different linear graphs with different maximum values. The FCTS EPICS panel also gives the trigger rate per trigger line.

If you have to restart the FCTS Display or the Run Monitor, press the button in yellow at the bottom of the screen. (See figure 6.22.)

6.2.10 bfo-con04: The Level 3 Trigger Information and Logging Manager

The bottom display shows two EPICS panels and a strip chart which lets you monitor the rate of events feeding into and out from the L3 trigger globally or by trigger line. This can be useful in identifying problems with the L3 trigger. The top display shows the output of the L3 trigger. All this L3 information is excellent for coordinating the effects of high backgrounds on data with the LiveFastMonitoring which the Navigator uses to perform data quality assurance. Pilot and Navigator should both use these displays and make notes as to what they see during prolonged, high backgrounds.

Restarting the L3 EPICS panels

To restart the L3 EPICS panels, strip chart and dislay, press the button outlined in red in figure 6.23.

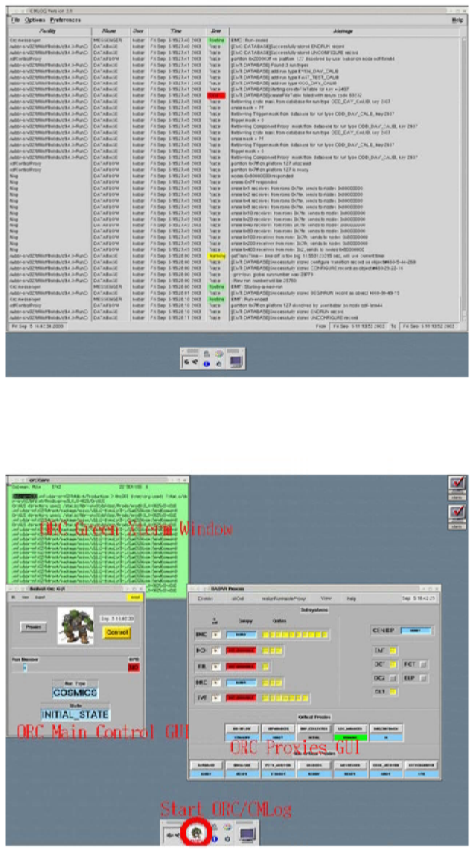


Figure 6.21: The ORC main control GUI and CMLOG. If either is not running you can restart them by pressing the button outlined in red. (If both are already running then pressing the button does nothing.)

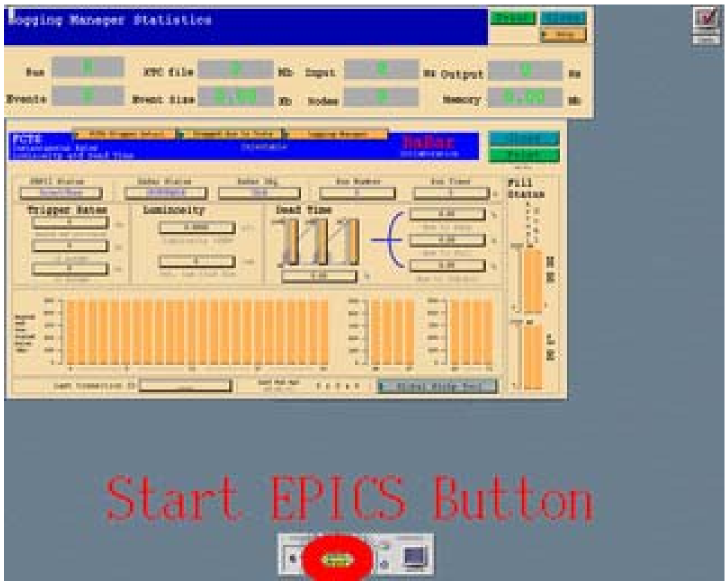


Figure 6.22: The Logging Manager and FCTS EPICS panels. To restart both panels, press the button outlined in red.

Introduction to the L3T Display and EPICS Panels

The middle display shows a two EPICS panels and a strip chart which lets you monitor the rate of events feeding into and out from the L3 trigger globally or by trigger line. This can be useful in identifying problems with the L3 trigger. The top display shows the output of the L3 trigger. All this L3 information is excellent for coordinating the effects of high backgrounds on data with the LiveFastMonitoring which the Navigator uses to perform data quality assurance.

The L3T display is a nice sanity check that nothing crazy is happening with BaBar. It is also useful for spotting hot towers due to the EMC or EMT. A hot tower cannot be missed; a large section of the L3 display will turn bright red.

As a new shifter, you care about the L3T EPICS panel mostly in the sense that you want to make sure that the L3T output rate is something like one tenth of the input rate. From your training shifts, you will know what the actual typical values will be.

The Level 3 Event Display

Instructions concerning the Level 3 Event Display are found at
BFROOT/www/Detector/Trigger/operations/L3EventDisplay.html.
These include instructions on how to set up the Level 3 event display, how to run from a trickle stream, how to run from an XTC file and an explanation of the different parts of the display.

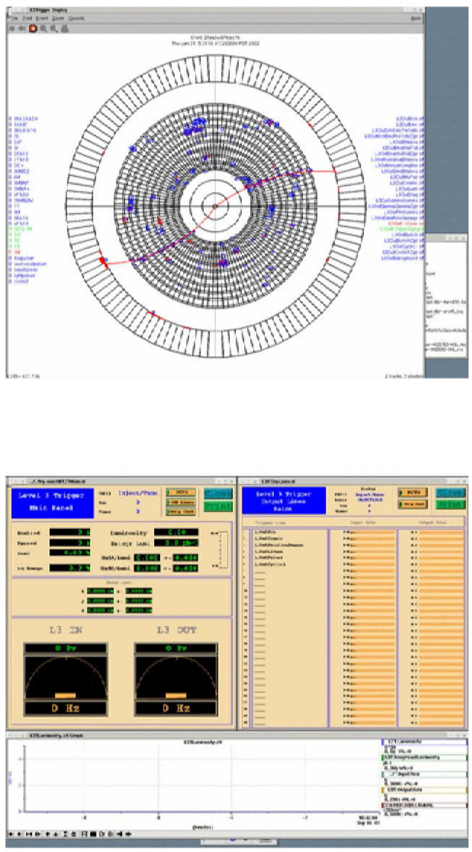


Figure 6.23: The Level 3 trigger EPICS panels, strip chart and display can be restarted with the EPIC button outlined in red

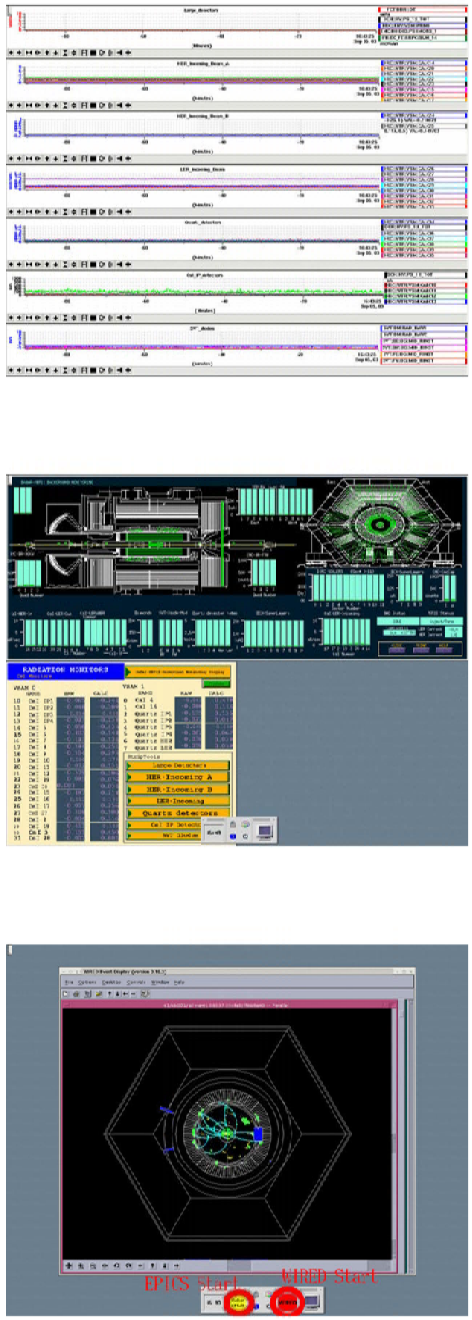


Figure 6.24: The background stripcharts (top) and background display (middle) show information about the backgrounds that BaBar is seeing. The WIRED event display (bottom) shows BaBar data in real time.

The Logging Manager

The function of the logging manager is to collect and merge the xtc files from the L3 farm nodes, where they are stored during a run, to one of the two merge servers (bfo-log100 and bfo-log101). The Logging Manager GUI is discussed in Section 6.3.

6.2.11 bfo-con05: The DQM Console

See the web page BFROOT/www/Computing/Online/EventProc/docs/DQM_overviewupdate.html for more information on this console.

6.2.12 bfo-con06: WIRED and the Background Display and Strip Charts

The bottom screen contains the WIRED event display which shows BaBar data in real time. Like the Level 3 Trigger display, it gives a nice overview of the functioning of the DAQ system. You restart it by pressing the button shown in figure 6.24.

The top two screens show information about backgrounds that BaBar is seeing. The display gives a nice graphical overview of whether backgrounds are high (just look for any yellow or red) in addition to detailed information about background levels, and the strip charts show how these levels change with time. Restart the background information with the button shown in figure 6.24.

6.3 Know Your GUIs

The Online Run Control (**ORC**) system is interfaced via a single Graphical User Interface (GUI) located on bbr-con03:0.0 (The lower console). Starting in January 2005, the GUI from which you exercise all control over the system is the Run Control section of the *ORC Main Control GUI*. This GUI is described in the following subsections.

6.3.1 The Run Control Section

The Run Control GUI, outlined in red above, combines the old Run Control and Proxies GUIs and is the window from which you will exercise your primary control over the DAQ system. The states of Run Control are described in section 6.5.

You can access extra features from the buttons in the tool bar at the top of the GUI. For example, **settings** will pop up a new window which displays Trigger Mask, run length and XTC file size information. Click the OK button in the widget to close the widget.

Expert actions, such as the complete exiting of all ORC processes or the emergency collection of Level 3 HBOOK files, are exercised from the **EXPERT** menu. The panel which is accessed from this button is detailed below in section 6.3.3.

6.3.2 The Proxies Section

The Proxy Section (shown highlighted in blue in Figure 6.25) contains buttons which represent the many proxies which connect Run Control and EPICS (The Component

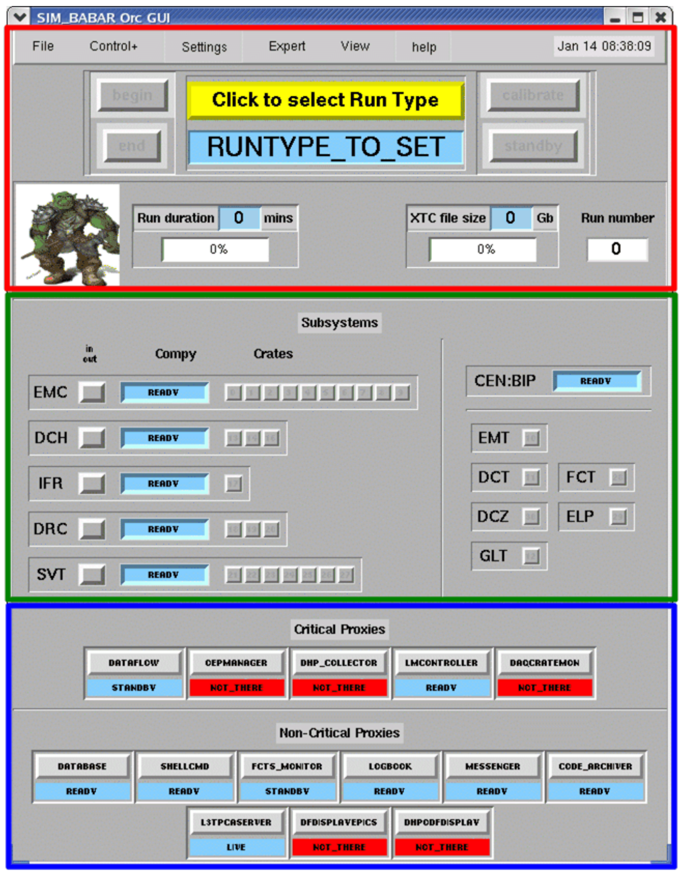


Figure 6.25: All primary control over the DAQ system is exercised from the Run Control section at the top of the ORC Main Control GUI. This is highlighted in red.

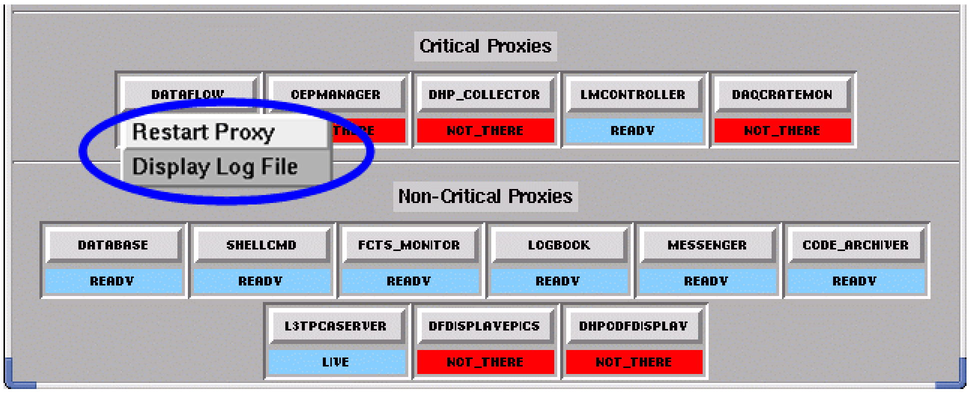


Figure 6.26: To restart the dataflow critical proxy, click on the dataflow button and then select the "Restart Proxy" menu item circled in blue. All of the critical and non-critical proxies have a similar menu.

Proxies) as well as proxies which interface Run Control to crucial non-detector systems (The ORC Proxies).

The Component Proxies display the status of the subdetectors high-voltage, the Fast Control and Timing (FCT), and the CEN:BIP interface. They are in the care of the Online Detector Control experts.

Proxies communicate with the Run Control state managers via an object known as the DNS. A loss in communication with the DNS can often result in strange proxy behaviour, such as proxies which spontaneously and chronically show PROBLEM states.

- **To remove/insert a Subsystem from the Crate Mask** Go to the STANDBY_STATE of Run Control. Next to each subsystem name (eg "EMC", "DCH", etc.) is a button that is either yellow and read "in" if the subsystem is in the crate mask, or is grey and reads "out" if the subsystem is not in the crate mask. Press the button to toggle whether the system is in the crate mask. You may also enter a crate mask manually by editing the selection CHANGE_CRATE_MASK from the main control button in the run control GUI.

- **To ignore/respect a Component Proxy** go to the STANDBY state of Run Control, left-click on the button of the Component Proxy that you want to ignore or respect. (In figure 6.25, these buttons are circled in red.) If you need help deciding when to remove a Component Proxy from the domain, see the DAQ FAQ (section 6.9).

- **To restart a runnable proxy**, click on the "Expert" button on the toolbar and select the "Restart Runnable Proxy Process" option. A window will appear asking you to confirm your action; proceed, and be patient – it takes time for the restart process to execute.

- **To restart any proxy besides a runnable proxy**, place the mouse pointer over the desired proxy and click the left mouse button once. A menu will appear; this menu is shown in figure 6.26. Select "Restart Proxy", outlined in blue in figure 6.26. A window will appear asking you to confirm your action; proceed, and be patient – it takes time for the restart process to execute.

- **To dismiss the GUI**, click the DISMISS button in the upper-left corner of the window. Alternatively you can click on the "Click here to dismiss this window and to reclaim control of the Main Orc GUI" button.

The states of the component proxies can be summarized as follows:

1. **READY**: All systems functional, ready to take data.
2. **CONFIG_LOCKED**: Monitored system is locked into data-taking.
3. **NOT_RUNNABLE**: The voltage for the monitored subsystem is not at its nominal data-taking value (V1). This is normal during a Ramp Down for PEP II injection, but should be investigated during other situations.
4. **PROBLEM**: There has been a loss of communication between Run Control and the Proxy. Try restarting the proxy and if that fails, try restarting the DNS (see 6.4).
5. **ERROR**: The proxy has suffered an internal error. Try restarting it (see 6.4) and if that fails, page Online Detector Control.

The states of these proxies themselves perform useful features and provide useful information to other systems:
The ORC Runnable Proxies are described as follows:

- CEN:BIP:X: Records Run Control transitions in EPICS for integrating luminosity and displaying DAQ status.
- DCH_COMPY: READY status of DCH.
- SVT_COMPY: READY status of SVT.
- IFR_COMPY: READY status of IFR.
- EMC_COMPY: READY status of EMC.
- DRC_COMPY: READY status of DRC.

The ORC critical and non-critial proxies monitor or communicate with processes that are required for ORC to run properly. Roughly speaking, problems reported by the critical proxies requires immediate action that ends the current run and interferes with data taking. While problems reported by the non-critial proxies need immediate action too, they can usually be fixed in a way that does not interfere with data taking.
The ORC Critical Proxies are described as follows:

- **DATAFLOW**: The Dataflow proxy controls the status of the Dataflow system, which itself is in charge of functions such as allocating or rebooting the DAQ crates partition and sending the configuration requests to the ROMs in the DAQ crates. Changes in the state of Dataflow are correllated with the overall changes in the state of Run Control.

- **OEPMANAGER**: Keeps track of all farm-node processes that are running.

- **DHP_COLLECTOR**: Makes histogram files at the end of the run, and updates the log book.

- **LOG_MANAGER**: Keeps the log manager running.

- **DAQCRATEMON**: This proxy looks to see if any of the DAQ crates do not have power. If they do not have power, it will go to error and a run will not start or continue unless the subsystem of the crate without power is masked out by the cratemask. The DAQCRATEMON proxy will not go to error if CEN:MON is restarted.

The ORC Non-Critical and Process Proxies are described as follows:

- **DATABASE**: This proxy controls interactions with the database and will reflect any problems talking to the database.

- **SHELLCMD**: This proxy allows Run Control to talk to the operating system on which it is run.

- **FCTS_MONITOR**: The monitor proxy sends information about dead times and trigger rates to the FCTS (Fast Control and Timing Systems) displays (see sections 6.4 and 6.2.3 for information on the FCTS displays.

- **LOGBOOK**: At the beginning and end of a run, this proxy writes tandard information into the electronic logbook.

- **MESSENGER**: This controls the voice messages which follow certain transitions or actions in the DAQ system; for instance, during initialisation without selecting the run type, during errors in the system, or when a run pauses.

- **CODE_ARCHIVER**: This proxy keeps a record of the code used in the current online release.

- **L3TPCASERVER**: This proxy monitors that the L3TPCASERVER has not died. The L3TPCASERVER provides various epics panels with information regarding the L3 trigger.

Each ORC critical or non-critical proxy has a different set of possible states. The important thing is that the box beneath each proxy name should be blue or green.

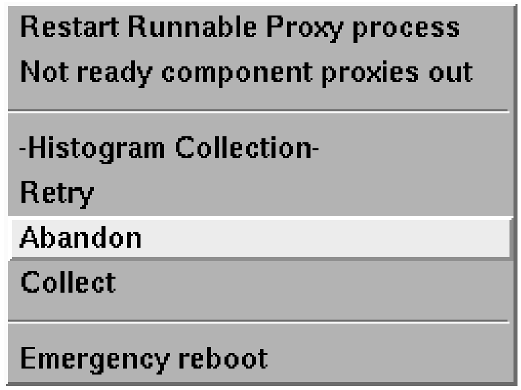


Figure 6.27: The Expert Menu is accessed from the ORC Main Control GUI, and allows the shift crew to obtain extra information about the system or to assert emergency control over aspects of the system.

6.3.3 The Expert Menu

The EXPERT MENU allows the shift crew to obtain extra information about the system or to assert emergency control over aspects of the system. Some of these features are described as follows:

- **Restart Runnable Proxy process-** is dicussed in Section 6.3.2.
- **Not ready component proxies out-** excludes component proxies that are not ready.
- **Histogram Collection-** contains options for killing Farm Node OEP processes and for performing an emergency collect of Level 3/OEP information about a run (see 6.4).
- **EMERGENCY REBOOT** performs a kill and reboot of the current partition. This should only be used when a run has ended in ERROR and one or more partitions are left over.

6.3.4 The View Menu

The VIEW MENU shown in Figure 6.28 shows the different log files that the shifter may access.

6.3.5 The Calibrator GUI

To obtain this GUI, you must click on the CALIBRATE button. The calibration GUI appears in front of the main control GUI. The pilot should not be able (and should not need) to edit the main control GUI during the calibration process.

The main features of this calibration GUI are as follows:

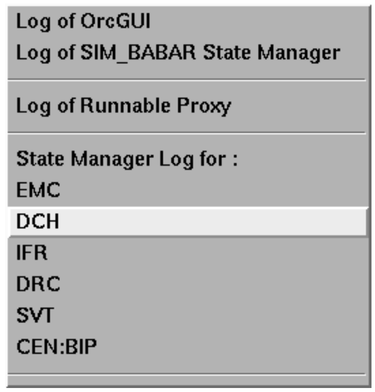


Figure 6.28: The View Menu is accessed from the toolbar on the ORC Main Control GUI.

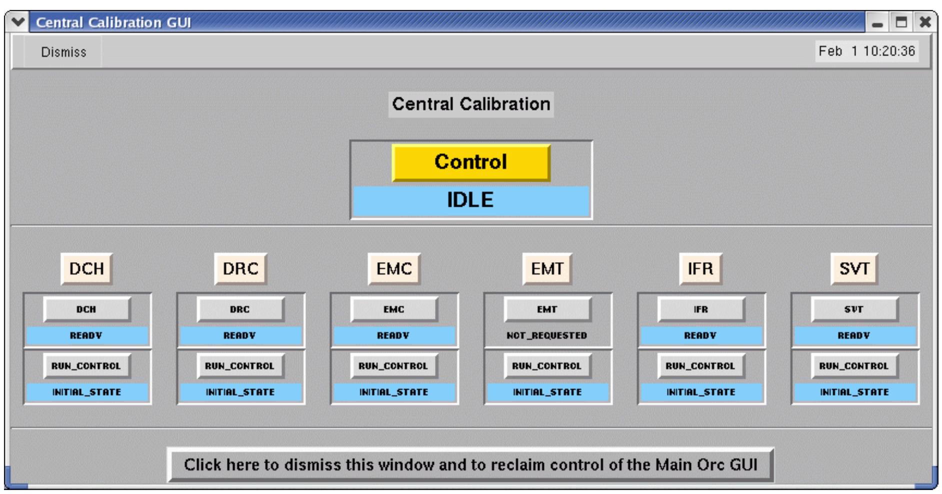


Figure 6.29: The Calibrator GUI, which is used to take global calibrations of BaBar.

- **The Control Button**: From the control button there are two options. These are CALIBRATE and RESET. You can calibrate (CALIBRATE) all the subsystems which have been requested for calibration. Individual subsystem requests are made from the menus attached to each subsystem button, described below. You can also reset the calibrator GUI to its original state by selecting the RESET button.

- **The Subsystem Buttons**: Below the Control Button you will see subsystem buttons. Once the Calibration GUI is started all the subsystems EXCEPT for the EMT will be requested for calibration. The label under each button will reflect the readiness for calibration of each system, and you cannot calibrate a subsystem until it is READY. If you decide not to calibrate a certain subsystem you can click on it and choose EXCLUDE. Once EMC starts calibrating, EMT will be requested automatically. After EMC starts its VALIDATING stage, the EMT will start CALIBRATION. The EMC and EMT can never be calibrated together because they use the same crate mask.

  Once a system is READY, you can either perform a global calibration on all requested systems from the CALIBRATOR button or individually calibrate by selecting CALIBRATE from a ready subsystem's button.

- **The Subsystem States**: Beneath the subsystem buttons are the flags for the current state of each subsystem before, during, and after calibration. During calibration these will change in accordance with the state of each subsystems DAQ crate partition.

Complete information about calibrating is described in 6.6.

6.3.6 The Logging Manager GUI

The Logging Manager GUI shown in Figure 6.30 shows the status of each run and of each merge server.

You should check this display occasionally to see if it is showing any errors or unusual conditions. In particular, the normal states for runs are:

- Active (green) - run is still in progress.
- End-pending (olive) - waiting for a new run or an unconfigure.
- Merging (blue) - merge in process.
- Complete (black) - merge is complete.

If you see runs listed in red (merge failed) or orange (awaiting merge) this indicates a problem and you should page the OEP Manager as listed on the whiteboard or Run Contacts webpage.

The normal states of the servers are either IDLE or ACTIVE. If any other state is listed, such as FULL or DEAD, then you should page the OEP expert.

There are various corrective actions that can be taken through the Logging Manager GUI, but these are reserved for experts, and pilots should not attempt to manipulate the servers or runs without guidance from an expert.

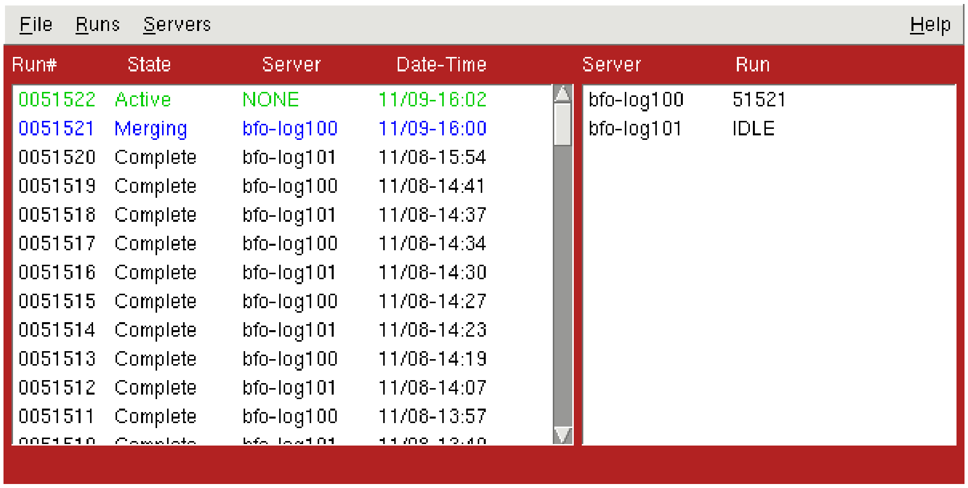
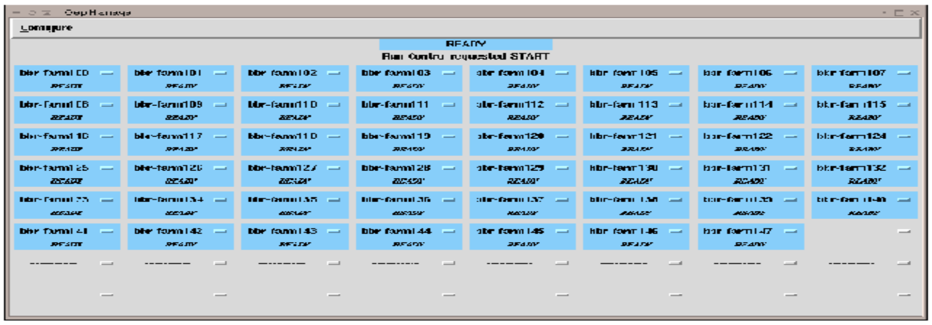


Figure 6.30: The Logging Manager shows the status of each run and of each merge server.

If someone reports that an xtc file is not available for one or more runs you can check the status of the run on this GUI. If the run status is "merging", the user should wait for the merge to complete (usually less than 10 minutes). If the status is end-pending, and the DAQ system is CONFIGURED, you can force the merge by doing an UNCONFIGURE. You can also force the merge by selecting the run in the Logging Manager GUI, and then selecting Retry from the runs menu. If the run state is anything else, including "complete" then you should page the OEP expert.

6.3.7 The OEP Manager GUI



The OEP Manager GUI displays the status of the unix farm nodes that run the L3 trigger processes. You can also use this GUI to start and stop individual farm node processes, view their logfiles, and configure some variables that control the overall use of the farm node processes.

The GUI consists of a single window in which there is a single button showing the state of each individual farm node. The name of the farm node is shown on each button, as well as the name of its current state. The button also changes color to reflect the state of the farm node. The initial, or idle, state is called READY, and is colored ”run control blue”. The normal operational states are CONNECTING, ALLOCATED, MAPPED, CONFIGURED, and RUNNING, and these states are purple, blue, cyan, dull green, and green. There are several error states, which are yellow, orange, or red. If a farm-node process dies for any reason (including if you kill it on purpose) the state is DEAD, and the color is magenta.

If you click on any of the farm-node buttons, you will get a menu of three choices: kill, start and view logfile. The kill command simply stops the farm node process, and start restarts it. Note that start does not kill it first, so if it is already running, and you want to restart it, you must kill it first. The view logfile command brings up an xterm window running the ”less” command on the current, or most recent logfile of the L3 process. This will show the same information as the xterm windows used to show, for those of you who are familiar with the older farm-node console display.

The top line of the window shows the overall state of the OepManager, which is a run-control proxy. This state should match the state shown for the OepManager on the run control proxies window. The second line of the OepManager window gives a one-line ”explanation” for the most recent activity that brought it to its current state.

The menu bar of the OepManager window contains a single item, called ”Configure”. There are two items on this menu: ”Node counts”, and ”Timeout”. The node counts command brings up a dialog which allows you to set three variables:

Max To Use: The OepManager keeps track of all farm-node processes that are running. It may sometimes be desirable to use less than the full complement of running nodes. This variable limits the number that will be used. The default value is 60.

Min To Use: This variable controls the minimum number of farm-nodes that must be available in order to start a run. If there are fewer nodes available when you request allocate, the allocate will fail. This number currently defaults to 30.

Max Failed: When you are starting a run, any error reported by a farm-node will abort the operation. However, once you are running, some errors are tolerated without aborting the run. Presumably the nodes that fail will be trimmed by dataflow. The max failed variable specifies the limit on the number of errors that will be tolerated. If this limit is exceeded, the remaining nodes will be aborted, and the OepManager will enter an error state.

The Timeout menu item allows you to specify the maximum time that the OepManager allows for all of the farm nodes to reach a consistent state. The timer starts as soon as the first state change is reported, or when run control requests a new action (e.g. START). If the timeout expires and the nodes are not all in the same state, then all nodes will be aborted, and the OepManager will enter an error state.

6.4 Know Your Tools

There are many tools available to the shifter to diagnose and solve problems, as well as to simply monitor the system behaviour. This section discusses tools for diagnosis and troubleshooting.

Monitoring HBOOK Files

After every run it is good practice to verify that the HBOOK file for the previous run has been written. Begin by checking the Electronic Logbook for the last run and verifying that all fields are filled. If this is not the case, look for the HBOOK file. These files collect in the directory:

```
/nfs/bbr-srv02/u4/Monitoring/Outputs/IR2LiveL3/
```

You can determine the timestamp of the latest file by typing:

```
ls -ogtr | tail
```

and looking at the last file returned by this command. Check the date and time and make sure it coincides with the last run's end time.

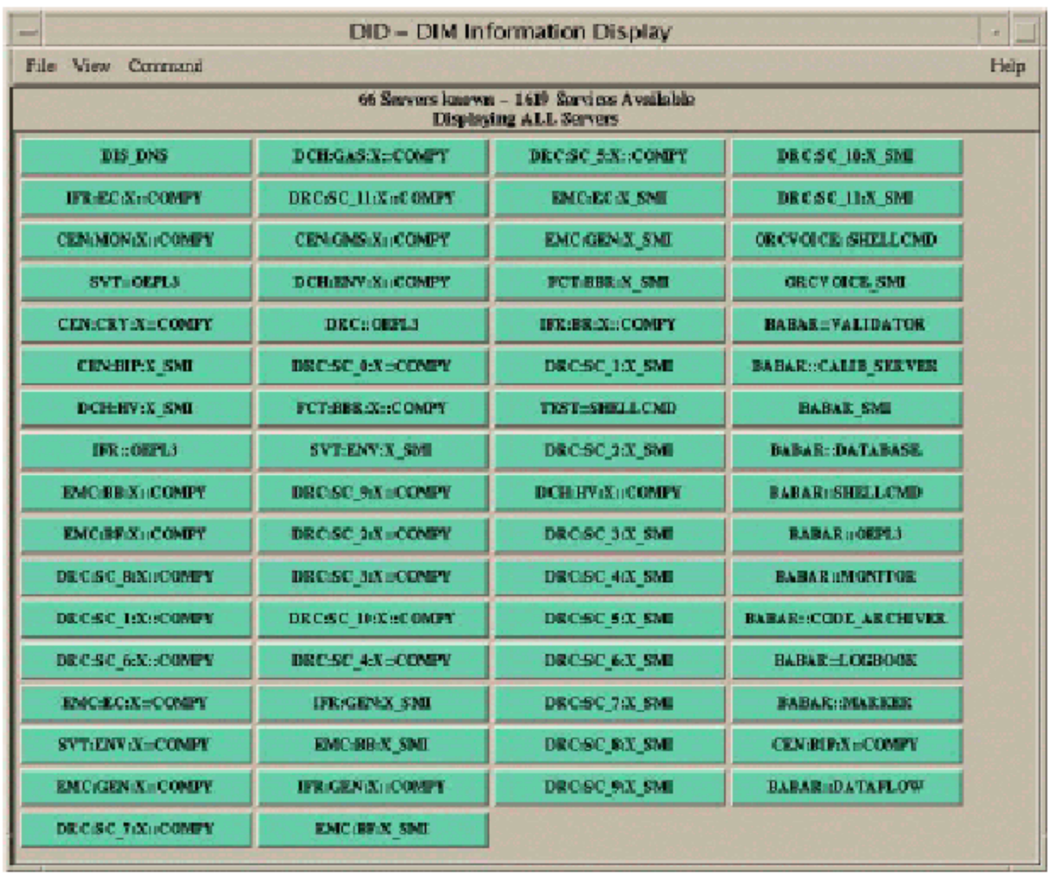
If an HBOOK file from a previous run is missing (either because the run ended in ERROR or the collect which creates the file simply did not succeed) and you have not yet started a new run, then you can create the file yourself. In the Run Control GUI expert menu, click COLLECT. Wait a few moments and then check the aforementioned directory and verify its creation.

DID

DID (DIM Information Display) is a program which "tattle-tales" on processes in the DAQ system. To start DID, simply type the following in the orcXterm:

```
did &
```

This brings up a new window. Click on `View` and then select `All Servers`. This brings up a plethora of buttons, and if a system is behaving itself the button is green; it is red otherwise. DID is shown in the following picture:



Cleaning up Partitions

If a job using a given partition dies abnormally, the partition may not have been dissolved. This can happen, for example, if a subsystem calibration job crashes. Then the crates allocated to that subsystem are not properly freed, and Run Control will be unable to allocate them for the next BaBar run or calibration. Dataflow has provided some tools to help you diagnose and resolve such problems:

- `showPartitions`: You can check which partitions are allocated by issuing the following command from the orcXterm:

  ```
  showPartitions
  ```

- **From the EXPERT MENU**: Click on the **EMERGENCY REBOOT** menu item. Confirm that you indeed wish to proceed. Wait a few seconds and then use `showPartitions` to insure the data-taking partition is dissolved.

- `killPartition`: The first step toward cleaning up a partition is to dissolve, or kill, it. Do this by issuing the following command from the orcXterm:

  ```
  killPartition
  ```

  and follow its instructions.

- `rebootPartition`: Once the partition is dissolved, it is a good idea to reboot all the ROMs in that partition. Do this by issuing the following command from the orcXterm:

  ```
  rebootPartition
  ```

  and follow its instructions.

Restarting a Component Proxy

If the component proxies crash (they should all crash together), you should restart it from Run Control. In the expert menu, click on the "Restart Runnable Proxy process" button. (See figure 6.26.) A window will appear asking you to confirm your action; proceed and be patient- it takes time for the restart process to execute.

Restarting an Orc Proxy

If an Orc Proxy crashes, you can restart it from the Proxies section of the ORC GUI by positioning the mouse pointer over the desired proxy and clicking the left mouse button, selecting Restart Proxy from the menu that pops up, and pressing "ok" in the window that pops up. (See figure 6.26 Wait until the proxy says that it is READY again. If this fails, contact the DAQ expert.

Restarting the GUIs

If at any time the GUI freezes, crashes, or otherwise disappears, you can easily restart it by pressing the ORC icon (see figure 6.21 or by issuing the following command from the orcXterm:

```
OrcGUI
```

6.5 Taking Data with BaBar

This section is divided into two halves. This first half is meant for experienced Pilots who have used the DAQ many times but may need to have a refresher in the key steps. This first half is also intended to guide fresh Pilots or Navigators in the steps necessary for factory-mode data-taking.

The second half of this section is devoted to a state-by-state, step-by-step breakdown of starting a run. This is useful for both understanding the effect of your actions on the actual system as well as troubleshooting the system.

6.5.1 Factory-Mode Data-Taking

- **Starting From Scratch**:

  1. Log onto bbr-con03 as *babar* and type:

     ```
     orcXterm
     ```

  2. In the green ORC xterm which appears, type:

     ```
     runOrc
     ```

     This will bring up the ORC Main Control GUI.

- **Running the DAQ**:

  1. When the GUI first appears, should you wish to take a run (rather than calibrating) then you must select a run type by clicking in the yellow box that say "click here to select a run type". Choose PHYSICS for colliding beams, COSMICS or COSMICS_L1PASSTHRU for cosmic rays.
  2. Once you have selected a run type then ORC will go into a STANDBY state.
  3. Select BEGIN.
  4. In the event of unstable or high-background beam conditions, then you may need to pause the run manually. To do this, click on "Control+" on the toolbar, and then select "PAUSE". ORC then moves from its RUNNING state to a PAUSED state. If you remain PAUSED for more than 5 minutes due to bad backgrounds, end the run and contact the Liaison (if there is one) or PEP-II operator (if there is no liaison)to discuss the conditions. You may resume the run by clicking on "Control+", and then selecting "RESUME". ORC then moves back to its RUNNING state.
  5. To end a run, select END.

6.5.2 Data-Taking: Step-By-Step

The major states of the run control system are as follows:

1. RUNTYPE_TO_SET
2. STANDBY
3. CONFIGURED
4. RUNNING

The following will describe, in detail, what you can do in each of these states. There will also be some detail about what happens "behind-the-scenes" when you make state transitions.

The RUNTYPE_TO_SET

- The RUNTYPE_TO_SET state of run control is the state into which ORC always puts itself when it is started from scratch. When a runtype is selected from the run type list, you are selecting a runtype which is an alias for a database key, which itself is a representation of many configurations from the configurations database. These configurations are later used to configure each subsystem's ROMS to receive the kind of data hinted at by the run-type name.
- **REFRESH_RUN_TYPE_LIST**: Anytime a run type alias is changed to point to a different key in the configurations database, the list must be refreshed. Usually the DAQ operations manager or a subsystem expert with database access will make these changes and instruct the Pilot to refresh the list. The pilot should refresh the list by selecting 'Control' from the toolbar and then 'REFRESH_RUN_TYPE_LIST'.

The STANDBY State

- When you go from the RUNTYPE_TO_SET to the STANDBY state, defaults for the selected run type are retrieved from the database and the 'click here to select a run type' display changes to the name of the chosen runtype.
- STANDBY is the state in which you can select which crates to use in the partitions (by default, all are used) and which trigger lines to use. This is done as follows:
  - **ALLOCATE**: Clicking on 'Control+' and then 'ALLOCATE' will take the crate mask and use it to tell the 47 OEP Farm Nodes which DAQ crates are to be used in the partition. This causes ORC to move from the STANDBY state to the DF_ALLOCATED state. Also, the status displays in the OEP Manager which show the status of each L3 node should change from Read (blue) to Connecting (purple) to Allocated (dark blue.)
  - **Changing the crate mask**: Clicking on 'Settings' brings up a window in which can modify the crate mask. Select 'Apply' when you are done to instantiate your changes and then 'OK' to close the window.

  - **Changing the trigger mask**: Clicking on Settings' brings up a window in which can modify the trigger mask. Select 'Apply' when you are done to instantiate your changes and then 'OK' to close the window.
  - Neither the crate mask or the trigger mask is supposed to be calculated by the shifter nor changed without the direct instruction of the Trigger Group. If you change either of these, note the change and reason why in the logbook.

- From STANDBY you can begin the run by selecting 'BEGIN', after which ORC moves from a STANDBY state to a RUNNING state as described in Section 6.5.2. However, while moving between the STANDBY and RUNNING states, ORC goes through two states known as DF_ALLOCATED and CONFIGURED. As a shifter during normal running you should not need to manually configure ORC through these states. For completeness, the DF_ALLOCATED and CONFIGURED states are described below.

The DF_ALLOCATED State

Once the partition has been allocated dataflow goes to its ALLOCATED state. For data-taking, it is best to simply choose BEGIN to begin the run at this point. Choosing to manually perform the CONFIGURE step (Select 'Control+' and 'CONFIGURE') should only be done if there is a problem in beginning a run that needs to be diagnosed. You may return to the STANDBY state by either selecting 'Control' and then 'DEALLOCATE' or just by clicking on the 'Standby' button.

1. **BEGIN**: This step begins by mapping the partition into the ROMs. This takes on the order of a second, and puts you into the READY state of run control. From there, the system automatically configures the ROMs and the nodes for data-taking, which can take up to 30 seconds. While this is happening, the OepManager nodes will change color as each farm node is configured.

   Once these two steps have completed successfully, the system will try to take data. If any Component Proxies are NOT_RUNNABLE (for instance, during an injection) the system PAUSES and waits until the proxies are READY. Then the system goes to RUNNING and the Component Proxies go to CONFIG_LOCKED.

   If any Component Proxies are in ERROR or PROBLEM, the run control system will go into the ERROR state. This can be cleared by selecting 'CLEAR'.

2. **CONFIGURE**: This step again begins by mapping the partition into the ROMs and puts you into the READY state or run control. From there, the system automatically configures the ROMs and the nodes for data-taking and the OepManager windows change color as each farm node is configured.

   You will then be in the CONFIGURED state.

   Any Farm Node which failed to connect to the partition before it was mapped will see the CONFIGURE transition as illegal, and put you into the ERROR state of run control.

3. **DEALLOCATE**: Selecting this option will shutdown all the Farm Nodes and issue a REBOOT to the ROMs in the partition. You will be brought to the STANDBY state.

The CONFIGURED State

This stage is most commonly reached by having manually performed the CONFIGURE step (Select 'Control+' and 'CONFIGURE') while in the ALLOCATED state. Once the ROMs and the nodes have been configured, you can simply BEGIN a run.

1. **BEGIN**: Select this and the system will try to take data. If any Component Proxies are NOT_RUNNABLE (for instance, during an injection) the system PAUSES and waits until the proxies are READY. Then the system goes to RUNNING and the Component Proxies go to CONFIG_LOCKED.

   If any Component Proxies are in ERROR or PROBLEM, the run control system will go into the ERROR state.

2. **Changing the trigger mask or crate mask**: You can change the trigger mask or crate mask by selecting 'Settings' as described in Section 6.5.2.

3. **Standby**: Selecting this option will unconfigure all of the ROMs and the Farm Nodes, then shutdown all the Nodes. No REBOOT is issued to the Partition. ORC goes to the STANDBY state. The same is achieved by selecting 'Control+' and UNCONFIGURE.

The RUNNING State

Entering the RUNNING state writes a new run record to the electronic logbook. You should verify that this has occurred.

In the RUNNING state, you can either END the run or return to the standby state. If any Component Proxies go into a NOT_RUNNABLE state, the system will PAUSE until they return to READY.

This latter feature is advantageous for factory mode, because the Pilot will ideally never have to touch the DAQ system. It will pause when we ramp down, and resume when we ramp up.

Ending a Run: You should only end a run manually if beam or detector conditions change or a top off conveniently coincides with the aforementioned criteria. The latter is rarely the case when we are in double trickle injection mode.

When taking colliding beam (PHYSICS) data then the system will automatically roll over to a new run after 55 minutes. When taking all data other than from colliding beams, the run will end automatically but you will have to manually start the next run as described above.

You should verify that the END transition wrote the Level 3 information about the previous run to the electronic logbook. If this has not occurred within a minute, verify that the HBOOK file has been created and if not, use the OEP COLLECT to create it. (see section 6.4 under Monitoring HBOOK Files).

6.6 Calibrating Babar

- **To Calibrate**:

1. Coordinate the calibration with any natural loss of the beams, and make sure PEP II is aware of our desire to calibrate. This should be done once every 24-48 hours.
2. Take the ORC back to its STANDBY state. To do this, end the current run by selecting END , then select STANDBY.
3. From the ORC Run Control GUI, select CALIBRATE.
4. A new GUI, the Calibration GUI (6.31), will appear. The main GUI will still appear in the background but the pilot should not be able (and should not need) to use it during the calibration process.
5. By default, all subsystems except the EMT should be included in the Global Calibration.
6. After EMC starts CALIBRATING, the EMT will be automatically requested for calibration. Once EMC starts VALIDATING the EMT will start it's calibration. You cannot do both simultaneously because they use the same crate mask.
7. If you have instructions not to calibrate a certain subsystem, click on that subsystem's larger button and choose EXCLUDE (see 6.32).
8. To start the calibration, select CALIBRATE from the Control button. This will cause the IFR, SVT, DCH and DRC to ramp automatically. You may see some alarms on the alarm handler while this is happening.
9. Calibrations can take up to 8-10 minutes, depending on the subsystem.
10. If a system succeeds in calibrating (hardware-based) and validating (software-based), it displays FINISHED_OK under its button.
11. If a system fails its calibration or its validation, it displays FAILED under its button. Look in the CMLog, the Farm Node window for that subsystem, and the Calibrator GUI for any error messages that might clue you into what happened. Take notes on these messages. Click on its button and select CLEAR.

    If this is the first failure, try to calibrate it again by clicking on its button and selecting CALIBRATE. Do this for any system **except** *the DIRC, due to the long time required for DIRC calibration.*

    Never try to calibrate a subsystem more than twice, and always contact the experts for the subsystem which fails. Be sure to know whether it failed calibration or validation.
12. Once the calibration is complete, press the "Close" button in the left top of the calibration GUI. The calibration GUI disappears and the main control GUI becomes active again.

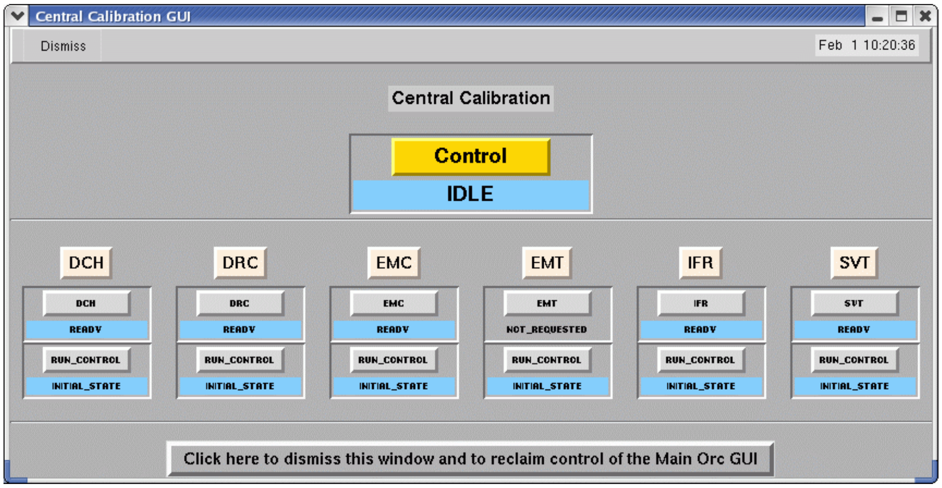


Figure 6.31: The Calibration Window

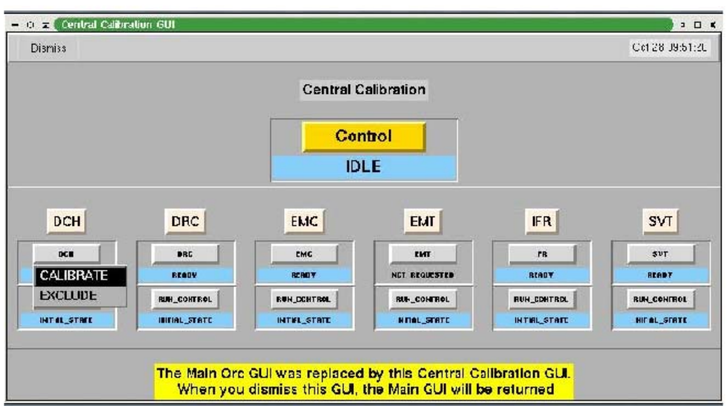


Figure 6.32: The Calibration Window; How to exclude subsystems

6.7 DAQ Crib Sheets

Please note! this is a useful summary of instructions, but you need to **read carefully the DAQ instructions** too, in order to fully understand how to operate the system.

6.7.1 DAQ CRIB SHEET

Starting from scratch:

Press the orc icon at the bottom of the screen of bbr-con03. This is a "smart" icon that will not start a new copy of ORC. To start ORC via a command line interface:

- Open a NEW Xterm on bbr-con03 and from it, run "orcXterm"

```
bbr-con03> orcXterm
```

- The green Orc Window appears and in the Orc Window (or orcXterm) type "runOrc"

```
bbr-srv03> runOrc
```

- The ORC GUI will appear.
- Click on yellow "Click to select run type" button to the desired run type.

Killing ORC:

- From the orcXterm, run "OrcProcKillOrc"

```
bbr-srv03> OrcProcKillOrc
```

- Follow the instruction above to restart ORC

6.7.2 PHYSICS CRIB SHEET

Getting ready to run:

In the Run Control section of the ORC GUI do the following:

- Click on the yellow "Click here to select run type" button and select **Physics** (if not already selected)
- On the Run Control section of the ORC GUI select **Begin** (to begin running)
- On Run_Control section of the ORC GUI select **End** (to end run)

THINGS TO REMEMBER:

- Please make lots of notes in the logbook, you can never be too verbose. Leaving detailed information is very helpful to experts.
- We can run without component proxies, so if there is a component proxy problem that can't be quickly solved, you may remove the offending proxy(ies) while in the initial state and take data. More details can be found here.
- Keep an eye out for error messages in CMLOG, and make a note of the error messages in the logbook.
- If a run ends in a dataflow error, you should check if an hbook file with a time stamp of the end run time was created in /nfs/bbr-srv02/u4/Monitoring/OutputArchive/YEAR/{the number corresponding to the current month}/IR2LiveL3/. If it wasn't created, you need to press the EXPERT button on the ORC GUI and bring up the Expert GUI. In the Expert GUI, click on OEP Control button and select COLLECT. This will make the proper hbook file.

6.7.3 IFR COSMICS CRIB SHEET

TAKING IFR COSMICS

From Epics:

- Make sure we are in DENY mode for injection
- From the state machine panel place the detector into manual mode by pressing the change button under the 'HV MODE'
- Open the IFR EPICS folder (making sure there are no alarms)
- Open the IFR configuration panel from the IFR EPICS folder
- Put the IFR in LOCAL mode by clicking on GLOBAL
- Set the IFR state to INJECTABLE
- Check here if you have or have not to turn ON some external Layers in Forwad Endcap.
- Set the IFR state to RUNNABLE
- Ramp up the DCH. Do this from their HV epics panels - which can be brought up by clicking on the system's brown button in the High Voltage section of the State Machine EPICS panel (on the left of the circle that indicates global/local control)

From ORC:

- Return it to its STANDBY state and set the run type to COSMICS_L1PASSTHRU
- From the **subsystems** panel of the main ORC GUI, include the the following sub-detectors: IFR + GLT + DCH + DCT + EMC + EMT + CEN:BIP

- Change the trigger mask to 10000001 (dch trigger) by clicking on the "Settings" option on the main ORC GUI toolbar and editing the "New Trigger Mask" box in the pop-up window that appears. Click "Apply" to save the new trigger mask and "OK" to close the pop-up window.

- IFR expert only: IFR expert could ask to take cosmics with different subdetector and trigger mask (for example to take plateau curve of Fwd Endcap) . If you don't receive different requests from IFR follow the standard instruction and bypass this point.

- Begin the run (Click on the "BEGIN" button on the top left hand side of the ORC GUI).

- When finished, return to the STANDBY state and then restore the default trigger mask by clicking on "CONTROL+" and then "RESTORE_DEFAULTS". Change the run type back to PHYSICS before starting a new run.

- Send an e-mail to IFR Operation Manager indicating the cosmics run number (thanks) and also record this information in the electronic logbook.

From Epics:

- Set the IFR to INJECTABLE

- Turn OFF those channels that you turned ON before going to start

- Return the IFR to GLOBAL mode by clicking on LOCAL

- Back out the DCH from local mode in the same fashion

- Double check that all detectors are in global mode and ramped down before permitting injection

- Make a thorough note of your activities in the logbook

6.7.4 DAQTEST CRIB SHEET

When To Take DAQTEST Runs

DAQTEST runs should be taken following extended periods without collisions, especially after hardware and significant software work have been performed, for example after periods of controlled access and RODs.

DAQTEST runs are taken to ensure that the DAQ system is functioning properly during periods of no collisions and can be run when there is beam in the machine.

Following a DAQTEST run it is critical to return the system to a state where it is waiting for collision data.

How To Take DAQTEST Runs

From ORC:

- Shutdown ORC. Restart it by clicking on the ORC icon.
- From the ORC GUI, click the yellow "Click here to select run type" button and set the run type to DAQTEST.
- Check your runnable component proxies. (The six along the top of the proxies GUI.) If any of them are red (and the SVT, DCH and IFR proxies at least should be red if you have not ramped up BaBar) then you must tell run control to ignore those proxies by clicking on them and selecting 'Out'. They should turn grey.
- If anybody is working with a subsystem's partition then you must mask out that person's subsystem. Do so by selecting 'change crate mask' from the main control button. A masked out subsystem is grey, and included subsystems are yellow.
- Begin and End the run as usual
- When finished, return to the STANDBY state by clicking on the "STANDBY" button.
- Restore the default settings by clicking on "CONTROL+', "RESTORE_DEFAULTS". All proxies will autmatically be included again on the next run.
- Set the run type back to PHYSICS.
- Select BEGIN. ORC will now begin taking data when the detector goes runnable.
- Make a thorough note of your activities in the logbook.

6.7.5 SINGLE BEAM CRIB SHEET

When to Take Single Beam Data

If only the LER or HER beam (ie one beam) gets lost and they can't refill immediately, single beam data should be taken. If there is a single beam loss, check with MCC on how long they'll have only one beam in the ring. If they expect more than 5 min and they are in STABLE BEAMS (not INJECT/TUNE) tell them you are going to take HER/LER-only data. Single beam data can now be taken even when MCC is trickling. Step by step instructions:

- In the state machine, click on Injection Allowed "PERMIT" (to permit trickle injection)
- In the state machine, put the HV Control into "Automatic"
- In the state machine, click on the blue "Single Beam - Denied" button to make the transition to "Single Beam - Allow". The detector will ramp up, and BaBar will go from injectable to runnable

- In ORC, click on "Standby" and select the run type "BACKGROUND", then click on "Begin"
- In the logbook, after the run started, click on the run number and set the run type to "Stable Beams"

At the end of single beam running, check the status: You want to make sure you will have HV in "Automatic" mode and "Permit" injection and return to run type "PHYSICS".

6.7.6 COSMICS CRIB SHEET

When to Take Cosmic Runs

Cosmic runs should be taken following extended periods without collisions, especially after hardware and significant software work have been performed, for example after periods of controlled access and RODs.

Cosmic runs are taken to ensure that the detector and DAQ system are functioning properly during periods when no beam is expected and they should only be taken when there is no beam in the machine.

Following a cosmic run it is critical to return the system to a state where it is waiting for collision data.

How to Take Cosmic Runs

From the BaBar State Machine Epics Panel:

- Make sure we are in DENY mode for injection
- From the state machine panel place the detector into manual mode by pressing the change button under the 'HV MODE'
- Ramp up the detector by pressing the blue 'Ramp' button on the right side of the panel

From ORC:

- From the ORC GUI, click the yellow "Click here to select run type" button and set the run type to COSMICS.
- Begin and End the run as usual
- When finished, return to the STANDBY state by clicking on the "STANDBY" button.

From the BaBar State Machine Epics Panel:

- Ramp down the detector by again pressing the blue 'Ramp' button
- Permit injections
- Return the detector to automatic mode by again pressing the change button under the 'HV MODE'

From ORC:

- From the ORC GUI, click the main control button and select RUN TYPE. Set the run type to PHYSICS

- From the main control button, select BEGIN. ORC will now begin taking data when the detector goes runnable

- Make a thorough note of your activities in the logbook

6.7.7 BFO-SRV02 / TAO NAME SERVER RESTART CRIB SHEET

What to do if bfo-srv02 is rebooted or if the TAO naming service is restarted for some other reason

The Computing expert will restart bfo-srv02. Ideally this should be done between runs after the histogram collection from Level 3 and from Fast Monitoring is complete. If this is not done, those histograms will be irrevocably lost.

After the restart:

- The TAO Name Server will restart automatically.

- The "ODC archiver watchers" will detect that the archivers' names are no longer visible and will restart them automatically.

- The pilot should kill, then restart ORC. To do this, exit Run Control and go to the green orcXterm. Hit "enter" to reach the command prompt, then type:

```
> OrcProcKillOrc
```

- You will be asked if you want to "dissolve partitions", hit enter (default no). Close all windows including the green and all white xterms. Click the ORC button at the bottom of the screen to restart ORC (this may take a few minutes).

- Once ORC is restarted the DQM should perform a full shutdown and restart of fast monitoring. This is covered in the DQM shifter instructions.

6.7.8 IR2CONTACTDB CRIB SHEET

IR2ContactDB is a web based application for managing IR2 paging and contact information in a MySQL database. It replaces the old "expert pager web form" but is also a database of the contact details for each system. This web form is located on the lower screen of bbr-con02. The help/introduction web page for this is found at
http://bbr-onlwww.slac.stanford.edu:8080/IR2ContactDB/IR2ContactDB.html

6.7.9 How to page an expert

The primary way to page a subsystem expert is by using the “page a system” section of the IR2ContactDB web form.
http://bbr-onlwww.slac.stanford.edu:8080/IR2ContactDB/page.php.

To page a subsystem expert:

- Select the subsystem expert you wish to page.
- Write the mesage you wish to send in the box. The web form can send a page of up to 256 characters, but the advised length is around 80 characters as this fits on one screen of the pager. Please include as much detail as you think necessary for the expert to gain a simple understanding of the situation.

  NOTE: pages such as “x5255” or “need assistance, call IR2” are not encouraged as they convey little information to the experts on call.
- If the web form does not work (It can take up to 5 mins to send a page so be patient) you can call the pager number from a phone. In this instance the message you should send is the IR2 telephone number (926 5255). After dialing the pager number, you will either get a voice recording from the system expert, or a beep. You then enter the message number followed by the # key.
- If you have received no response 5 minutess after paging the expert, call the appropriate cell phone. The phone numbers are located on the main white board, the expert on call is identified by the red magnetic dot.
- If you cannot reach the expert via cell phone, you should call the other numbers associated with that subsystem.
- If you have received no response 15 minutes after the initial page, page the Run Coordinator.

6.8 Miscellaneous Troubleshooting Tips: What to do whenever a DAQ problem occurs

- Do not forget that known problems and their solutions are outlined on the DAQ webpage, accessible from the BaBar homepage at:

  www/Detector/Operations/shifts/DAQDoc/BaBarDAQTroubleshooting.html
- Try to detect what is causing the problem: start by using the run control GUI to look for any anomalous state for any of the proxies, then move on to the other displays at your disposal.
- Give yourself a few minutes to try to solve the problem; also see the Troubleshooting Guide .

- If you don't think you can solve the problem, page the daq-expert on call using the expert web page . Be ready to answer the call of the expert, by summarizing briefly what are the symptoms of the problem and which actions brought you to the problem. This will save precious time.
- Report in the e-logbook times and actions taken by you and the expert(s).
- **THE PAUSE & RESUME MYTH** Okay pilots, its time to put a rest to this myth once and for all. If we get 100% deadtime, PAUSING AND RESUMING WILL NOT HELP, rather it can lead to a dataflow error and in the end, waste more good beam time than need be.

  If, however, the 100% deadtime persists for longer than 60 seconds, and there are no associated backgrounds, page ODF.
- **ODF Damage Interpretation** Matt Weaver gave the following advice for shifters in interpreting the severity of dataflow errors:
  - ODF damage to just a few events is OK and can be expected
  - ODF damage to a lot of events is bad
  - FEX errors are probably dangerous as these are set by the individual subsystems only when serious problems arise
- **If a node crashes (node trimmed)**
  1. Page the Level 3 Expert (day and night) (and NOT the Trigger Commisioner!).
  2. Be PATIENT – the DAQ system should recognize that it has lost a node and stop sending events to it. At that point the triggers will resume. You'll see a message on the CMLOG saying "Event level node NN trimmed", so you can identify the culprit.
  3. Continue taking data until the next top off/beam loss. Then UNCONFIGURE, CONFIGURE and BEGIN a new run (see also the last point about 'stuck' XTerm windows).
  4. If the run does not resume then you need to UNCONFIGURE, CONFIGURE and BEGIN again.
  5. If the L3 XTerm window(s) does not go away when UNCONFIGURED use the OEP->Kill button in Run Control. Verify that the partition has been dissolved. If that is not the case, kill the partition.
- **Talk to your Navigator shifter:**
  - Make sure that the Navigator examines the first two plots on the L3 page regularly. These should be the elapsed time and number of events passed for each L3 node.
  - If any L3 node is different than the others, then there is a potential problem. If one is significantly lower than the others, then check cmlog to see if a node has been trimmed (there should be a red error message). If so, just treat it as any other node trim (see below).

  - If no node has been trimmed (double check this!), then page Level 3.

- **If you have *any* problem which causes you to reboot CEN:BIP during data taking: First, pause data taking, then reboot CEN:BIP, and then resume data taking. Otherwise a false state will be recorded for BABAR DAQ.**

6.9 The DAQ FAQ

1. What is a "Partition"?

   - A "Partition" is any sub-group of the DAQ crates which are used for actual data-taking. By default, all DAQ crates are and should be used for data-taking, but as DAQ shifter you can control which are actually used. See sections 6.4 and 6.5 of this chapter for more information.

2. What is the difference between masking out a crate(s) from the partition and disabling one of the component proxies?

   - The Component Proxies are state machines which connect Run Control to EPICS and tell you the current operating state of the system to which they are assigned.

     In their role as watchdogs, if they indicate that there is trouble with their component, they will and can prevent actual data from being taken (for instance, a run will pause in the middle of data taking should a component proxy become NOT_RUNNABLE).

     The partition, however, is the actual set of crates being used for data taking. You can mask out a set of DAQ crates (e.g. in the EMC) but if you leave the EMC proxies active, then they will respond to problems/changes in the state of the EMC. Therefore, even though DAQ crates are not used for data taking, the proxy watching the corresponding subsystem can interrupt data-taking if the subsystem reports trouble.

     Please read the next question for more detail.

3. When should I disable component proxy?

   - A lot of this is left up to the shifter, and comes with experience. But here's an example that might aid your decision:

     A subsystem is having intermittent problems, which happen perhaps once or twice per fill. The subsystem has been alerted and suggest you continue taking data with it. You do notice that every time the subsystem has trouble, its component proxy goes into a NOT_RUNNABLE state and pauses data-taking, but becomes READY again shortly thereafter, and data-taking continues. This is a good time to END the run (END) return ORC to STANDBY (STANDBY), and take the proxy out. Leave the subsystem crates in the partition so that we continue to collect data.

Chapter 7

Detector Controls

7.1 Using EPICS Panels

General instructions for using EPICS may currently be found at BFROOT/www/Detector/Operations/shifts/DetCont.html.

7.1.1 Starting EPICS

For BaBar shift crew:

- Click the *EPICS* button on the lower leftmost console display (bbr-con01:0.0).
- Click the *EPICS* button on the lower middle console display (bbr-con02:0.0).

For everyone else:

- Logon to bbr-devXX as yourself.
- >source /nfs/bbr-srv01/u1/babar/epics/devel/release/site/epicsSetup; BaBarMain;
- You will probably want to create an alias for the above command.
- If you just wish to set up the environment, without launching the main panel, omit the BaBarMain command.

7.1.2 Restarting EPICS

- Shift people: press the ‘start EPICS’ button again.
- Others: From the window where you started EPICS type ‘BaBarMain’.

7.1.3 How to Navigate

The EPICS display panels should be intuitive; if they are not, the designer has not done their job properly and comments are welcome. Below is a brief description of the mouse button functionality.

- Left Mouse Button - The main tool used to navigate and perform certain actions, e.g. turning on the HV.
- Right Mouse Button - Some buttons are links to multiple secondary panels. To see the menu of panels linked to a button, press and hold the right mouse button. Move the mouse up or down until the particular panel you are interested in is highlighted, then release the button. In many cases, this will enable you to skip a level. Right-clicking on the "Print" button will bring up a printer dialog box.
- Middle Mouse Button - The middle mouse button performs a sometimes useful feature. If you position the cursor over an object that is associated with an EPICS channel, pressing the middle mouse button will bring up a display showing the name corresponding to that channel. In some situations, the actual name of a channel in an abnormal state may be of more use to an expert on the phone. This panel will also have an examine button. Pressing this button will display the database entry (including alarm limits) for the channel.

7.1.4 Getting Help

Many panels will have a button in the upper righthand corner labeled "Help", which should be connected to a web page with useful information about that panel. If you find that clicking the button brings up the generic help page, or there is no Help button, and you feel that more information for that panel would be useful, send email to me and I will ask the appropriate expert to create such a page.

7.1.5 The BaBar Main Panel

The main BaBar panel shows a summary of the major systems. All buttons should be green to indicate that the system is in a normal state. If any of the buttons are red, some component is not in its proper running state. This may be intentional, e.g. someone is working on the system and a power supply is unplugged, but you should determine the current status of that system and note it in the BaBar log book. Many of the problems indicated this way are such that data should not be taken. For most problems, this is handled automatically by the component-proxy talking directly to run-control via the runnable flag.

Most of the buttons on this panel have extensive right mouse button actuated drop down menus.

Note especially the "Alrm" button. Pressing this button brings up an image of the Alarm Annunciator Panel. Pressing the alarming button will take you quickly to an EPICS screen which will speed diagnosis of the alarm, and with any luck, to help on how to respond.

The state of a channel is indicated by the display colors, green for OK, red for a major alarm, yellow for a minor alarm, and white for an invalid value. See subsection 7.2.4 for more on alarm types.

7.2 Starting and Using the EPICS alarm handler

The alarm handler program has several mode attributes. The first is global/local. In global mode, alh reads the alarm acknowledgement state of a channel from the IOC and writes an acknowledgement to that IOC. In local mode keeps such actions to itself. The next is active/passive. In active mode, alarms may be acknowledged. In passive mode they may not. A third attribute is silent/beeping. In silent mode, alarms provoke no sound, while in beeping mode, unacknowledged alarms cause a beeping sound. The default states are global/active/beeping for alh instances started on bbr-con01 and global/passive/silent for all others.

There is a five bit mask for each channel. The mask is represented on the display as five characters which may have the values [C—-] [D—-][A—-][T—-][L—-]. C means don't accept any alarms from this channel. D means log, but otherwise ignore alarms, A means automatically acknowledge alarms, T means that transient alarms do not need to be acknowledged, and L means do not log alarms. The - carry the converse meaning and are the default.

More on starting and using the EPICS alarm handler may found at BFROOT/www/Detector/Operations/shifts/AHInstructions.html.

7.2.1 Starting ALH

For the BaBar shift crew (i.e. when you are on shift and are looking at the alarm handler as seen on bbr-con01):

- The 'start EPICS button' will start the alarm handler.
- Click on the small alarm handler window that appears

For everyone else (i.e. when you are not on shift and not looking at the alarm handler as seen on bbr-con01):

- Follow the instructions to start EPICS (see subsection 7.1.1).
- >cd $DAPPDIR/all/alh
- >alh.new BaBar.alhConfig &

An alternative that should also work (when not on shift) is to press the ALH button on the odc_main EPICS panel. Using the right mouse button will give you a menu of options for the alh modes. This option is not available while on shift/dealing with bbr-con01.

7.2.2 Restarting ALH

For the BaBar shift crew (bbr-con01):

- Use the 'start EPICS' button to restart everything.

For everyone else (while not on shift/not looking at the alarm handler as seen on bbr-con01)

- >cd $DAPPDIR/all/alh
- >alh.new BaBar.alhConfig&

An alternative that should also work (when not on shift) is to press the ALH button on an odc_main EPICS panel.

7.2.3 Navigating

When you first start `alh`, a small window will appear labeled MAIN; click on it to bring up the main window. To clear stale alarms, push the button (perhaps several times) to the left of the group MAIN in the left hand region of the main window. You will then be able to see the actual status of the systems.

The structure of `alh` is hierarchical, with individual channels combined into groups, which themselves can be members of a higher-level group. There are two regions in the main window, the one on the left is used to navigate through the group hierarchy, the one on right displays groups/channels below the currently selected group in the left window (to select a group, click on the name). Groups that contain sub-groups will have an arrow just to the right of the name. Click on the arrow to expand the branch one level down. Click again to collapse the branch. A quick way to cleanup many expanded branches is to click twice on the MAIN group. Double-clicking (as opposed to clicking twice) will expand all levels below the current level.

Some groups will have a button labeled "P" (for "panel"), which can be used to access an EPICS panel displaying relevant information for that group. Some groups will have a button labeled "G" (for "guidance"), which will bring up a brief message describing the possible source of an alarm and/or what to do in case of an alarm.

The display of the alarm tree has a bug such that the alarm states fail to refresh. Collapsing the tree and re-expanding it will usually force a refresh.

7.2.4 Responding to Alarms

There are three alarm levels recognized by the Alarm Handler:

- ERROR - Along with INVALID, the highest alarm level. It signals that a channel is currently not connected or there is some other problem with obtaining a value. This may just indicate that an IOC is rebooting, but it could indicate a more serious communication failure. INVALID alarms are indicated by a white box labeled "E". Persistent ERROR alarms should brought to the attention of the appropriate system operations manager.

- INVALID - Like ERROR, the highest alarm level. It signals that something is wrong with the obtained value. An example is a channel whose value was never defined. INVALID alarms are indicated by a white box labeled "V". Persistent INVALID alarms should brought to the attention of the appropriate system operations manager.

- MAJOR - Signals an error state that should be attended to immediately. Indicated by a red box labeled "R". The proper response should be indicated in the guidance provided for this channel, or for a group of which it is a member.

- MINOR - Signals a transient or persistent condition of a less urgent nature. Indicated by a yellow box labeled "Y". The proper response should be indicated in the guidance provided for this channel, or for a group of which it is a member.

Currently, any alarm will initiate a beeping sound to alert the shifter. The alarm status for each group is displayed just to the left of the name. Alarms are always initiated by a single channel, but the alarm status is propagated to the highest level, including the small MAIN window.

To determine the source of an alarm, follow it down until you reach the root group and then click on that group. All of the channels in the group will be displayed in the righthand region of the main window. You may have to scroll down to see the source of the alarm.

If the channel label is not descriptive enough to determine what the problem is, look for a link to an EPICS panel ("P" button) either next to the channel name, or next to one of its parent groups. If no EPICS panel is found, and you feel that there needs to be one, send mail to me. In this situation, you will have to go to the main BaBar EPICS panel and try to find the source of the alarm by navigating the offending subsystems panels.

To acknowledge an alarm, click on the button showing the alarm status. If the condition that caused the alarm has gone away, the alarm indicator will disappear, if it has not gone away, the indicator will remain but the beeping should cease.

Alarm masks may be set so that acknowledgement is not required, or not required once the alarm goes away. These are A and T masks respectively.

Acknowledging an alarm on one instance of `alh` will acknowledge it on all running instances. Alarms that have already been acknowledged will not be acknowledged on a newly started instance of `alh`.

Many “invalid” channels may indicate either that some power is off or that an IOC has crashed. The former condition should cause “major” alarms on the power supply monitoring channels. The latter condition will require rebooting the offending IOC. See Chapter 18.

See chapter 22 for more information on particular alarms.

7.2.5 Masking alarms

At times the condition causing an alarm cannot be fixed until a later time. You may wish to mask that alarm off. Select the offending alarm , then from the “action” menu select “Force Mask”. Select “Disable Alarm” and click “Apply”.

7.2.6 Saving and restoring alarm masks

The program which checks the difference between the current configuration and the default configuration, AlhDif, is automated. It creates a new report entry in the "Other Notes" section of the elogbook when it's restarted and from then on every 4 hours.

7.2.7 CMLOG

Use a CMLOG browser to identify transient alarms which don't require acknowledgement, determine alarm sequences, and review alarm histories. Selecting the *View CMLOG Log Browser* from the ALH *View* menu will launch a cmlog browser configured for alh alarms. Alternatively, you may click on the cyan *ALH* button on the main EPICS panel. The former will require additional selections from the *Options* menu to query a past period or initiate updating. The latter will launch with recent alarms already displayed and updating turned on.

7.3 Ambient database

7.3.1 Starting Ambient Explorer/Ambient Plugin

To start Ambient Explorer, click on the cyan button labeled "Ambient" on the main BaBar EPICS panel. After about 10 seconds you should see a splash screen quickly followed by the Ambient Explorer window with channel selector and display panes. To start JAS with Ambient Plugin, use the right mouse button on the "Ambient" button.

7.3.2 Overview

Ambient Explorer and Ambient Plugin for JAS provide hierarchical access to the ambient data using a directory tree for each system. On the left side of the window you will see an entry for each system. To expand a branch you can single-click on the bubble or double-click on the name. Eventually you will get down to a list containing channels. Double clicking once on a channel name will bring up the data for that channel in a strip-chart plot in a plot which fills the righthand window. Alternately, one can drag and drop the channel onto the display pane. This will generate a small plot which may be resized. Dropping a channel onto an existing plot will overlay the displays. Double clicking on another channel will replace all the plots on page 1 with the newly selected plot.

Both of these programs are feature rich. Explore the menus for options. The most commonly used menu items are found in the tuple menu. They are the DB search parameters and the tabulate selected columns. Right clicking on a plot will bring up a dialog for changing the plot properties.

Chapter 8

Operating Non-System Devices

8.1 The BABAR Protection System

(The object here called the BaBar defender does not have a single name. It consists of the SVTRAD system plus similar systems related to the DCH and the EMC. The BISM (see below) is implemented in EPICS.

The BaBar detector is protected by a system of devices and software intended to insure that the detector is not damaged by radiation, and in particular, that systems with HV gain are not subjected to radiation while the HV is at a high level. This protection involves monitoring the HV systems and PEP II, and tripping off HV systems or dumping the beams when things go awry. The heart of the system is EPICS based code called the BABAR Injection State Machine (BISM), which serves as the communications link between PEP, the detector and the BABAR shift people. The operation of ths EPICS based software will be described below. EPICS has links to PEP which report the status of several beamline devices, and coordinate PEP and BABAR operations. To dump the beam, EPICS is connected to the BABAR DEFENDER. The operation of these devices is described in detail in the following sections.

8.2 How to run BABAR Injection State Machine

8.2.1 Philosophy

The BaBar injection state machine is **not** responsible for the protection of BaBar.

Protection of BaBar from large doses of radiation is the job of the hardware abort system. The primary function of the BaBar state machine is to facilitate efficient running of PEP-II and BaBar in "Factory Mode". However, the state machine does provide the first line of defense against radiation damage by limiting the ability of PEP-II to inject beam while BaBar is in an unsafe state. If the machine operators are respecting our software, BaBar must be "INJECTABLE" for beam to enter the rings. Because of its nature, the EMC does not have the ability to reduce radiation damage by ramping its bias voltage. Until mid-April 2004, the DRC was not ramping up and down its high voltages as well; now it does. Therefore, BaBar INJECTABLE status is now defined with respect to the SVT, DCH, IFR *and* the DRC; it is the logical AND of the individual INJECTABLE flags. In addition, there is a hardware injection inhibit SIAM whose output is connected to a kicker magnet at the end of the LINAC and can prevent injection into PEP-II. There are currently four active inputs to this SIAM; three generated by software EPICS signals, and one connected to the INJECTABLE/NOT_INJECTABLE toggle switch located below the annunciator panel in the BaBar control room. The toggle switch is a fail-safe way to prevent further injection into PEP-II, but should only be used in emergency situations.

The injection state machine communicates with the PEP-II state machine used by the operators to inject into the rings. From the BaBar point of view, our responsibility is to **PERMIT** or **DENY** injection requests from PEP-II, and to bring the subsystems to the **INJECTABLE** state when PEP-II wants to inject, or to the **RUNNABLE** state when injection/tuning is complete and we want to take colliding beam data. The nominal state for BaBar should be to permit injection requests. The only exception is when we have "quiet time" when subsystems calibrate their detectors and may need to be "RUNNABLE", or at least in an unsafe HV state. Denying injection requests in this case is a precaution that adds a layer of comfort while the SVT bias and/or the DCH HV are up. While BaBar is taking colliding beam data we should always permit injection requests.

The ramping of BaBar can occur on a subsystem-by-subsystem basis (local control), simultaneously under the control of the BaBar Pilot (global control), or automatically based on the **INJECTION REQUEST** signal from PEP-II (automatic control). Automatic mode is currently not implemented. The three relevant subsystems (SVT, DCH, IFR) can choose to be under local or global control individually, depending on the situation. The nominal state should be that all systems are under local control (whether by the subsystem expert, or by the Pilot). Global (and eventually automatic) mode are designed to facilitate efficient transition of BaBar between the INJECTABLE and RUNNABLE states to reduce operational downtime and maximize useful luminosity. If a problem arises with an individual system while it is under global control, the Pilot should contact the expert (if it's the SVT) or go to local control and reset the system (for the DCH and IFR).

8.2.2 Implementation

The state machine is implemented as an EPICS sequencer running on the CEN-BIP IOC (Input/Output Controller), a VME cpu running VxWorks which lives in the CEN-BIP crate in rack 18 of the electronics house. This IOC is referred to as the "BIP", for BaBar Interface to PEP. It communicates with a similar IOC on the PEP-II side referred to as the "BIC", for Beam Injection Control. The current state of health of these two IOCs is displayed on the main BaBar EPICS panel under "BaBar/PEP-II CommLink", where it should say **CONNECTED** for the BIP and the BIC.

If the BIP says **DISCONNECTED** page babardaq.

Do not attempt to reboot the BIP yourself.

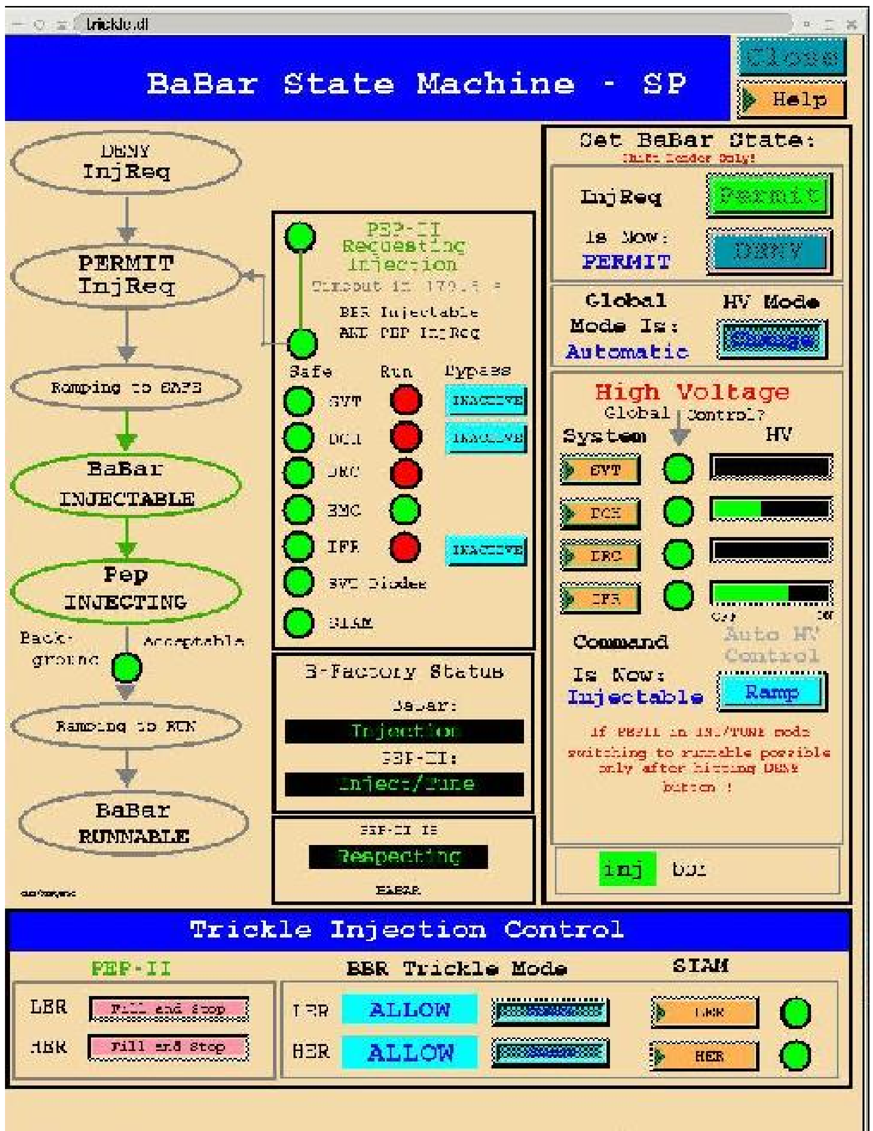
If the BIC is disconnected, inform the BaBar liaison (x5121), who should in turn inform the MCC operators (usually they will already be aware of the situation).

8.2.3 How to Bring Up the Display

Only the BaBar Pilot (userid "babarsl", usually running on bbr-con02) is authorized to control the state machine. If you are the Pilot, follow these directions to bring up the panel:

- Click on the "startEpics" button on bbr-con02

You should see this panel (or something close to it):



The status of BaBar and PEP-II is shown at the top-center in the box labeled ”B-Factory Status”. The possible states for each are:

BABAR

- **Inj Req Deny** - BaBar is denying injection requests from PEP-II.
- **Inj Req Permit** - BaBar is permitting injection requests from PEP-II.
- **Ramping Down** - BaBar is in process of ramping to safe for injection voltages.
- **INJECTABLE** - BaBar is INJECTABLE (ie, safe for PEP-II to inject).
- **Injection** - BaBar sees that PEP-II is injecting.
- **Ramping Up** - BaBar is in process of ramping to operational voltages.
- **RUNNABLE** - BaBar is ready to run in data acquisition mode.

PEP-II

- **No Beam** - There is no beam in either the HER or the LER.
- **Inj Requested** - PEP-II is requesting injection.
- **Inject/Tune** - PEP-II is injecting and/or tuning for luminosity.
- **Stable Beams** - PEP-II has stable beam in the HER and/or the LER.

The status display at top right indicates whether or not PEP-II is respecting the BaBar INJECTABLE flag. The display will change to **OVERRIDING** if they are not. If you see this state you should inform the liaison immediately and demand to know why they are overriding our software without BaBar's permission.

8.2.4 The State Machine

The BaBar injection state machine has 7 states (ok, it has a few more ”hidden states” but never mind). A description of each state follows.

InjReqDeny

After a reboot of the BIP, the state machine begins in the injection deny state. In this state, injection requests from PEP-II are completely ignored by BaBar. The only way PEP-II can inject in this case is to **OVERRIDE** the normal state machine functioning. This should never be done without the explicit permission of the BaBar Run Coordinator. (ie, this should *never* happen.) The override status is displayed in the upper righthand corner of the state machine panel, showing whether PEP-II is RESPECTING or OVERRIDING BaBar: The only way out of the InjReqDeny state is for the Pilot to press the green PERMIT InjReq button. Pushing this button will force the state machine into the InjReqPermit state.

The BaBar state machine also will jump to this state if any abnormal conditions, requiring human interference, are detected. These may be an unexpected switch of one of the monitored safe-state subsystems going unsafe during PEP-II injection, or any of these subsystems appearing to be disconected (corresponding EPICS channel is not readable). Another condition leading to injection request deny is the PEP-II override mode. An exception to the manual exit from InjReqDeny is the case when the only reason for getting into this state was SVT PIN diode calibration. Such a calibration happens from time to time when a special process detects that there is no current in both PEP-II rings. The calibration takes 35 seconds, and for this duration SVT asserts the SIAM injection inhibit signal. As soon as the calibration is done, the inhibit signal disappears and the injection state machine **automaticaly** goes to the InjReqPermit state.

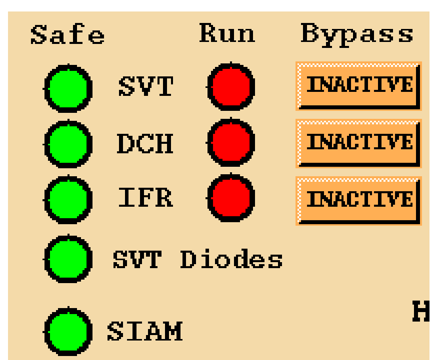
Of course, it will happen only if BaBar was not in InjReqDeny state before the calibration. When BaBar injection state machine enters **InjReqDeny** state, it always will show the reason for entering this state. When it exits, the text string showing the reason disappears.

InjReqPermit

This is BaBar's idle state. When PEP-II requests injection the corresponding indicator will light up and BaBar will transition to the "Ramping Down" state.

Ramping Down

When PEP-II requests injection, both state machines wait for BaBar to become safe. This occurs when the SVT, DCH, and IFR INJECTABLE flags become true AND when the injection inhibit SIAM is clear. When this condition is met, the BaBar INJECTABLE flag is set and the state machine transitions to the INJECTABLE state. It is possible for each subsystem's INJECTABLE flag to be BYPASSED. However, only the Pilot has permission to bypass the IFR. A bypass of this type should only be activated if the subsystem needs to do work that would normally cause it to go UNSAFE (eg, rebooting the IOC). The SVT and DCH subsystem experts will make the decision and implement bypasses of their systems, but they should always inform the Pilot first.



Three buttons are provided for bypassing the SVT, DCH, and IFR. Again, only the Pilot has permission to bypass the IFR, and only after being instructed to do so by an IFR expert. When a bypass button is active the label changes to "ACTIVE" and the color changes to flashing yellow.

INJECTABLE

Note: Even if all systems are safe and the SIAM is clear, BaBar only becomes INJECTABLE when PEP-II requests injection. In this state PEP-II is allowed to inject.

Injection

This state is entered when BaBar sees the PEP-II flag showing that injection is in progress. In that state the BaBar operator can't start ramping the bias voltages to operational values, even if he presses the **"RUNNABLE"** part of the **"INJECTABLE-RUNNABLE"** button. The button in fact will not obey, and will return to the "INJECTABLE" state. The only way to immediately stop injection in that case is to press **"DENY InjReq"**

Ramping Up

When PEP-II removes **Injection Request** BaBar state machine returns to **InjReqPermit** state. If the BaBar operator now presses the **"INJECTABLE-RUNNABLE"** toggle button, BaBar will go to the **"Ramping Up"** state.

Note: This state is entered only when BaBar and PEP-II are in handshake mode. If BaBar, for example, is in **InjReqDeny** mode, this state will not be entered, as well as all others. Biases in BaBar subsystems still may be controlled by the **"INJECTABLE-RUNNABLE"** toggle button if subsystems are in global control mode. The actual state of the global control signal may be seen by looking on the area between the **"MANUAL-AUTO"** and **"INJECTABLE-RUNNABLE"** buttons. If there is a green rectangle labelled **"inj"** then global control is telling all subsystems to go to injectable state. If there is red button with label **"run"** then it tells everybody to be ready for DAQ running.

RUNNABLE

BaBar will come to this state after all subsystems reach runnable conditions. It will leave this state when PEP-II is requesting injection. But the actual detector state will remain runnable until the operator pushes the **"INJECTABLE-RUNNABLE"** toggle button to go into the "INJECTABLE" state. So, even if BaBar state machine goes into its idle state, **"InjReqPermit"**, it does not preclude the BaBar data acquisition from continuing to run, and the state of BaBar detector would not change. This is only an additional signal to the operator that PEP-II wants to inject. If one of the subsystems watched by the state machine became not runnable, the state machine will return to the **"Ramping Up"** state. **Note:** "Ramping Up" and "Ramping Down" states have timeout periods. If after a preset period of time since entering such a state, the BaBar detector does not reach the desired state (RUNNABLE or INJECTABLE), the state machine will assume that something is not operating properly, and will go to the "InjPerDeny" state, requesting human action to proceed.

8.2.5 Trickle

Running with the LER trickling, we need to use the "trickle injection" state machine. The BBR Trickle Mode can be changed to ALLOW at any time prior to trickling. It should only be changed to BLOCK manually if the detector is in danger. The state machine logic can also set the BLOCK if the dI/dt value exceeds the tolerance.

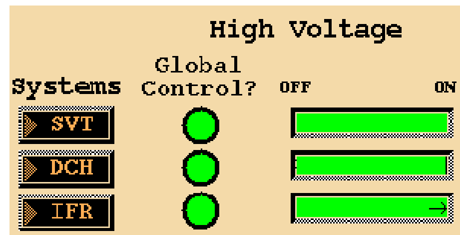
Some general notes about trickle... in order to trickle, these conditions must be met: BaBar is RUNNABLE, PEP is requesting trickle and BaBar's Global HV Mode is Automatic. If we are trickling and PEP withdraws the trickle request, BaBar remains RUNNABLE, the run and data-taking continues; there is no rampdown until PEP requests injection.

There are three parts to the Trickle Injection Control area of the State Machine:

- PEP-II This shows the activity PEP-II is currently performing. There are two options:
  - Fill and Stop: PEP-II is filling the beams.
  - Trickle: PEP-II is trickling the beams.
- BBR Trickle Mode
  This can either be ALLOW or BLOCK. Clicking on the CHANGE button changes the mode.
- SIAM Clicking on the LER or HER button brings up detailed information about the SIAM inhibits. In PEP-II mode 'Fill and Stop', the SIAM inhibits should show a green light in the 'OK' position. In PEP-II mode 'Trickle', the the SIAM inhibits should show a yellow light in the inhibited inhibit 'INH' position.

8.2.6 High Voltage Control

Three subsystems need to be ramped up and down depending on the state of PEP-II. While injection is ongoing the SVT, DCH, and IFR need to be INJECTABLE. This can be done in local mode or in global mode (the SVT state machine can only be run by the SVT expert, so it must be in global mode for the shifter to control it). The control status is displayed under the column labelled ”Global Control?”.



If the light is green it means that the subsystem is under global control. The current HV value for each system is shown as a horizontal bar, where full scale is the nominal high voltage value for that system. When all systems are under global control, you can raise and lower the high voltage by pushing the “Global HV Control” button labelled “RAMP”. The button works like a toggle switch; if “is now” reads INJECTABLE the systems are now at there injectable voltages and will ramp to their runable voltages, and vice versa. If for some reason a system does not respond to the global button, while it’s global control light is on, bring up that system’s HV control panel by clicking on the corresponding button under the column labelled ”Systems”. From there you can take the system out of global control and ramp it individually **(Note: the SVT can only be controlled in local mode by an expert)**.

8.2.7 Troubleshooting

The bug that caused the BIP to crash has been fixed. There should **never** be a need to reboot the BIP.

Last modified: 11/14/2003

Questions? Send email to: babarodc@slac.stanford.edu

8.3 BABAR Defender

8.3.1 Overview

The BaBar Radiation Protection System is a BaBar-maintained system designed to protect (and in some cases monitor) machine-induced background/radiation levels at the detector. In cases of alarm, the system can send hardware control signals to the PEP-II control system and inhibit injection or abort the beams DIRECTLY. The system has been designed to make hardware decisions and based on hardware responses which result in hardware results. In most cases, logic levels have been selected such that a disconnected cable or undriven input results in an interlock condition.

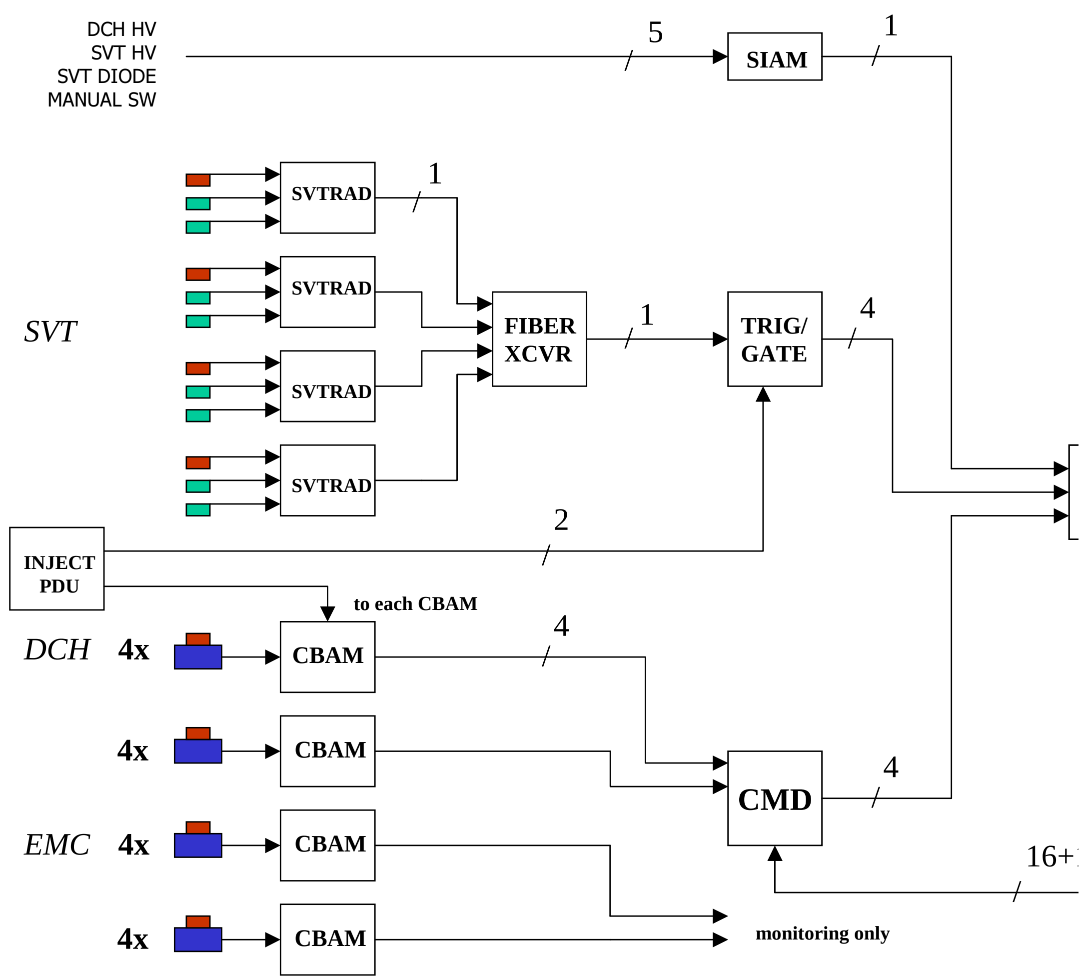
The system has been designed to grant PEP-II maximum flexibility while guaranteeing the safety and protection of BaBar. When an input goes into an alarm state (unsafe), the system determines whether the alarm is coincident (in time, at the 1 msec level) with PEP-II injection triggers. If the alarm transition is within the 1 msec window surrounding any of the 67 nsec individual injection pulses, the system *can* vote to inhibit injection in that ring. (By injection pulse/trigger, we refer to a copy of the electronic timing signal actually in sync with the injection of charged particles to an RF bucket of the ring. This is NOT the "PEP-II is injecting" EPICS level. The Linac can only deliver at a maximum of 120 Hz, and since each injection trigger is less than 100 nsec, it is clear the duty cycle of the injection trigger signal is VERY low.)

The major components in the system are listed below.

- Sensors in the detector (typically PIN diodes)
- Signal source, acquisition, and conditioning electronics such as the SVTRAD and CBAM modules
- Level shifting and command electronics in the Bld 624 IR-2 alcove, Rack B624-05

There are currently four main consumers of the BaBar Radiation Protection Electronics. The system allows each of the input channels to be configured to abort either beam or inhibit either ring's injection efforts when the input level goes unsafe (LOW, 0V, open, etc.). This configuration is maintained in the Command Electronics through a large block of two-pin hardware jumpers. These are from the following sources: (Note that the BaBar State Machine (implemented in EPICS) does NOT explicitly vote in the Radiation Protection Electronics via hardware.)

- SVT, via SVTRAD modules
- DCH, via CBAM modules
- EMC, via CBAM modules
- BaBar Central Systems, via a SIAM module, which summarizes :
    1. DCH high voltage state (hardware)
    2. SVT bias voltage state (hardware)
    3. SVT bias voltage state (software)
    4. Manual switch in IR-2 control room (hardware)
    5. SVT diodes injection inhibit (software)


DCH HV
SVT HV
SVT DIODE
MANUAL SW
5
SIAM
1
SVT
SVTRAD
SVTRAD
SVTRAD
SVTRAD
1
FIBER XCVR
1
TRIG/ GATE
4
INJECT PDU
2
to each CBAM
DCH
4x
CBAM
4
4x
CBAM
CMD
4
EMC
4x
CBAM
4x
CBAM
monitoring only

8.3.2 Signal Electronics

For additional information on the SVTRAD module and its radiation protection algorithms, please visit the SVTRAD Resource Center. There are four SVTRAD modules (FE, FW, BE, and BW), each of which generates a fiber optic radiation alarm signal that is cabled directly to the B624-05 rack. (signals are such that LIGHT-ON = SAFE) The SVTRAD modules are located on the detector in the SVT electronics racks.

For additional information on the CBAM (Camac Beam Abort Module) module and its radiation protection algorithms, please visit this website. There are 3-5 CBAM modules, of which only one is connected to the Command Electronics. The CBAM modules are located in Bldg 624 in rack B624-06, but rely on preamps which are located on the east side of the detector behind the shielding wall.

8.3.3 Command Electronics

The Command Electronics are the heart of the system, and are all located in rack B624-05. The Command Electronics comprises 3 types of modules, 2 of which are dedicated to interfacing with the SVTRAD system. The Command Electronics are:

- Fiber Transceiver Module, #350-755-18
- Trigger/Gating Module, #350-755-15
- Command Module, #350-755-16

The Fiber Transceiver Module receives the 4 SVTRAD fiber optics cables, and performs a logical combination of them to create a TTL level signal on the LEMO "OR Output" connector that is HIGH when all four SVTRAD modules report safe conditions and LOW when any of them sources a radiation trip. The existing module has 8 fiber optic connectors, only 4 of which are implemented.

```
 The current Fiber Transceiver Module in use is a wire-wrap module
originally built by Mark Petree in December, 1998.  There are no spares,
and no schematics.  The SVT crew is remedying this situation ASAP.
```

The Trigger/Gating Module performs the detailed injection coincidence timing for the SVTRAD signal, since the injection trigger pulses are not available on the detector where the modules are located. The Trigger/Gating Module accepts separate HER-TRIG and LER-TRIG inputs and internally stretches the injection trigger to form a timing gate. Each of the four alarm inputs compares the radiation trip signal with a gate of different width. In normal operation, the SVTRAD trip OR signal from the Fiber Transceiver module is connected to the fourth input, where it is matched to a 1 msec gate. (The HER-TRIG and LER-TRIG signals are derived from a NIM gating module in a bin below the crate containing the Trigger/Gating module. The NIM gating module, in turn, is cabled to a PEP-II PDU which relays the injection timing signals.)

```
 The current Trigger/Gating Module in use is a SLAC-built, standard PCB
module.  There is one spare (with schematics), filed with SLAC/BaBar via
Ray Rodriguez.
```

The Command Module is also labelled the "CBASM" or Camac Beam Abort System Module. Each Command Module handles a maximum of four sets of input channels; an input channel consists of four inputs: HER abort request, LER abort request, HER injection inhibit request, and LER injection inhibit request. The Command Module performs the necessary logic to combine the same-function inputs from each channel, and shifts voltage levels appropriately to drive the BATI and SBDL. The module also provides an internal latch for the state of any input (which can optionally be connected as a latch-and-hold), readout of the latched value, and a reset capability which clears all the latches at once.

We use two of these modules, daisy-chained together, to collect and combine the 4 sets of inputs into one of each of the four outputs:

- HER beam abort
- LER beam abort
- HER injection inhibit
- LER injection inhibit

Each channel (numbered 1-4) is divided into `!HA, !LA, !HI`, and `!LI` inputs, one each for asserting HER beam abort, LER beam abort, HER injection inhibit, or LER injection inhibit. A set of four jumpers per channel then selects which inputs are connected and driven. Each channel input is monitored by a latch, and the position of a second jumper per channel determines whether the internal state of the channel is held to the latch value (until reset) or if it clears when the input dis-asserts. This completely programmable flexibility brings us to a total of 48 jumper blocks on the Command Module (4 channels x 4 inputs each x (enable/disable + latch-and-hold + latch-only)).

The digital state of the Command Module's 16 latches are read out via an IDOM module in the PEP-II control system. Another channel allows the PEP-II operators to send the digital reset-latch command, which is daisy-chained between the two Command Modules. At present, only the SVTRAD inputs use the latch-and-hold feature; the CBAM and BaBar SIAM inputs are configured in the Command Module to clear the output state when the input clears. Thus, PEP-II cannot recover from an SVTRAD radiation trip until they assert reset-latch. This forces the operators to pay attention to injection inhibits and beam aborts.

```
 The current pair of Command Modules in use are the original wire-wrap
modules designed by Tom Mattison in Fall, 1998.  They are not robust.
There are two spares of the Command Module which are SLAC-built PCB
modules.  They are untested, but ready for configuration and use.  They
are stored in the left-hand slots of the B624-05 CAMAC crate.
```

8.3.4 Further Information

All beam-abort requests from the Signal Source Electronics internally tie the HER and LER beam abort requests together, because the front-end sensors cannot distinguish damaging LER backgrounds from HER backgrounds. All of the trigger/gating electronics furthermore assume that backgrounds coincident with a single beam's injection triggers are most likely from that beam's injection. Of course, once injection is inhibited, injection triggers will cease, and the next trip will immediately force a beam abort. (The CBAM modules handle the injection inhibit / beam abort decision in a slightly more complicated manner, so please see their documentation for more details.)

It is important to realize that the command electronics talk directly to the PR02 PEP-II control system, specifically the HER and LER Beam Abort Trigger Systems [BATS] (via a Beam Abort Trigger Interface panel) and the HER and LER Single Beam Dumper Logic [SBDL]. These hardware systems work directly with interlock magnets: the BATS aborts stored beams within 7 usec by firing an abort dumper magnet that can extract the beam in less than a full turn onto a copper beam dump; the SBDL logic can veto the injection of linac pulses into the PEP-II ring at the NIT or SIT points by steering the bunches onto the injection tune-up dump. These hardware control signals have unequivocable and irreversible consequences. They are (almost) impossible to bypass. For instance, even if PEP-II uses alternative injection techniques (such as diag list), the SBDL logic will still be able to stop them. (PEP-II does have the power to independently mask out BATI inputs around the ring, and therefore can, in the extreme case, bypass the LER and HER BATS at Region 2. The MCC control system has been designed to make this more difficult than weapons armament on most nuclear submarines, however.

The Liaison's job of working with the ensemble of systems here called the Defender, is described in great detail in the Liaison Shift Manual which can be found at /BF-ROOT/www/Detector/Backgrounds/liaisons/manual/.

8.4 SVT Radiation Monitoring and Protection

8.4.1 Introduction

The SVT cares deeply about radiation exposure and high background levels in PEP-II. To help ensure the detector's longevity and performance, a system (SVTRAD) of background radiation and monitoring has been installed that uses PIN photodiodes near the beampipe (within the SVT's inner radius). These 12 reverse-biased diodes provide a nA current level which contains a "dark current" pedestal, and a signal portion that is linear with incident radiation. 24 accompanying thermistors provide highly accurate, reliable measurements of thermal drift that are used to correct for the sinificant temperature dependence of the diode leakage currents. For radiation monitoring, these diode currents are digitized by 4 SVTRAD modules in the SVT MUX racks and then massaged in real-time EPICS to extract instantaneous dose rates and absorbed dose integrals, and then archive them.

The radiation protection is enforced by a specialized ABORT circuit that lives in hardware on the actual SVTRAD module. SVTRAD enforces two types of radiation thresholds, the so-called "actute" dose threshold (in mRad) which protects the SVT against sudden radiation spikes, and the "chronic dose threshold" (in mR/s) which protects the SVT from too much radiation dose too fast. (i.e. enforces the 2 MRad / 10 year radiation dose budget)

Conversion: 1 nA = 5 mR/s

Weekly updated performance reports from the SVTRAD system are generated and stored at the recentStatus page.

8.4.2 Tour of SVT Radiation/Background EPICS

The implementation of SVTRAD relies heavily upon EPICS. This section briefly describes SVTRAD EPICS. For complete information, it is essential to look at the EPICS panel specific help pages. EPICS provides two useful functions: alarm detection/handling, and display generation/updating. *For more documentation and supporting info, don't forget to check the SVT online EPICS help files, either through the web or available under the **Help** button on every SVT EPICS panel.*

Start from SVT TopLevel EPICS.

- **Background** This panel gives an immediate overview of the entire SVTRAD system. The matrix in the center of the panel provides real-time information on each of the 12 SVTRAD diodes. The instantaneous radiation dose rates are listed in Column 1. The next column shows the integrated radiation dose since the last MONitoring calibration. The third column shows the integrated radiation dose for each diode since the dawn of time. (The dawn of time for the forward diodes was much more recent than for the backward diodes.) The two columns of circular indicators show the Alarm status for each diode. Only the MID diodes are used in the Radiation Protection ABORT circuit; hence they are the only diodes which can honestly, say, be green or red. The alarm status is an OR of the radiation trip, a diode disconnect watchdog, the thermistor disconnect watchdog, and the module's Armed/Offline state. Ideally, none of these should be red, but a radiation trip will periodically turn them so. For more details, see the SVT EPICS web pages.There are three main sets of sub-panels available from this panel, all available by `right-click-and-drag-down-a-menu`. Read on:
  - The **Details** menu will provide access to the **Analysis, Readout, Trip History** and **Error Status** panels, which provide information about the tasks that turn ADC values into inline dose rates. Here also is some information about the most recent trip.
  - The **History Plots** button provides access to a menu of StripTool scripts which, when selected, will automatically load and start StripTool on various sets of SVTRAD signals. The last option, **View Integrated Doses** is a plot of the integrated radiation doses as observed by each diode, and is updated about twice a week.
  - The **Expert Controls** menu suite offers the user control over the calibration of SVTRAD, and the archiving system. **Calibrate Diode Dose Rates** is used for the MONitoring calibration, and **Calibrate ABORT Thresholds** is used to adjust the real hardware radiation trip thresholds to account for radiation damage. Here also are the **AUTO Fast History** controls, which configure and analyze the fastHistory buffers. Under this menu are also some summaries of radiation levels for the current shift, **Radiation Dose This Shift**. The SVTRAD softAbort system also lives under this panel, with the menu name **1-min. Diode Dose Rate Averages**. There is also access to the automatic diode dose rate calibration system under **autoDetect** which gives the diodes power to veto PEP-II injection. (i.e. the diodes have their own INJECTABLE flag.)

- **Background Alarms** There are several loose alarm conditions wired up to catch the most common error conditions. These errors will trigger the Alarm Handler, and also turn parts of the SVT EPICS **Background** Panel red. The alarm conditions are designed on a diode by diode basis, but if a module has a generic alarm condition, all three diodes serviced by that module will have the same alarm. The alarms are set by an OR of the following conditions, and a brief summary of their instantaneous state can be found under the **Background** –> **Details ==> Error Status** panel.
  - ANY CAN BUS FAILURE.
  - Temperatures from AUX HTEMP in alarm condition, or out of range [10,31] deg C.
  - ADC configuration of SVTRAD module not registered properly (will turn dose rates white).
  - ABORT diode configuration parameters not registered properly.
  - ABORT diode disconnect alarm.
  - ABORT diode's thermistor disconnect alarm.

8.4.3 Services that SVTRAD requires: Calibration

The PIN diodes at the heart of the SVTRAD system are Silicon, and are just as susceptible to radiation damage as any other piece of Silicon. We have recently estimated that the damage coefficient for the diodes is near 1 nA / kRad, where the 1 nA represent an increase in the nominal pedestal current of the diode. At the current levels of background in PEP-II, we can expect to accumulate several kRad per day in the worst diodes. The online software relies on measurements of the diode pedestal current during periods of NO BEAM. *Calibration means pedestal measurement for SVTRAD.*

SVTRAD requires two types of calibration, both with ZERO beams. The MONitoring calibration zeroes the strip charts and the online radiation dose rates by pedestal subtracting the ADC values when there is no radiation signal (i.e. no beam). A MONitoring "diode dose rate" calibration takes 35 seconds. The ABORT calibration actually adjusts the radiation trip thresholds in the front-end hardware based on in situ measurements of the diodes and thermistors. It requires ZERO BEAM and will take 20 seconds. Radiation damage, currently, erodes 10-15% of the trip threshold every day.

Both types of calibrations are now done automatically after a beam loss, and no action from the pilot is required.

This is the number one reason for complaints, concerns, and confusion about the SVT's radiation protection – negligence.

Please also see the Liaison Shift Manual for additional information about SVTRAD's daily needs.

8.4.4 Services that SVTRAD offers

Daily summary of trips

One can access the running total number of radiation trips for each diode through SVT EPICS. Use **Background→Details→TripHistory** and then press **TOTALS** and wait several minutes for an `xterm` window to appear.

Real-time radiation dose rates

The signals are averaged, gain multiplied, pedestal subtracted, temperature corrected and dose converted diode currents from the SVTRAD front end electronics. Key in their manufacture are the calibrations for pedestal subtraction and the temperature supplied by the AUX HTEMP modules. The design is such that these signals have very little deadtime. The online diode dose rates are used to form the radiation dose integrals that govern the SVT's radiation budget, and also as realtime, background tuning signals by the PEP-II operators. (Usually just the MID diodes, though.)

Integrated radiation doses

By integrating the real-time radiation dose rates, absorbed dose integrals are formed. These dose integrals are visible on the **SVT Background** EPICS panel, and a time history plot is available on the **View Integrated Doses** option under **History Plots**.

Fast History Buffer

Each SVTRAD module (servicing three diodes) carries a circular fastHistory buffer on-board. This stores nearly 3000 ADC samples, and at external request, can be read out post-mortem to see detailed time structure of an event. Reading out the fastHistory buffer necessarily freezes the ADCs on the module, and flatlines the strip charts until finished. The fastHistory buffer contents are transferred to a binary-encoded file in the `iocs/svt-mon/log/` area, where it is available for analysis at the click of an EPICS button.

At present there are two triggers for readout of the buffer to disk. The first is a manual EPICS button and the other the EPICS readback of the module's radiation trip status. The latest buffer can be viewed by pressing the view button on the "MCC Monitoring BaBar Summary" panel. Furthermore all radiation dumps are automatically listed in the FastArchive web page with link to detailed plots.

softAbort Chronic Radiation Protection

The SVTRAD front-end hardware has been configured to enforce an acute dose threshold that helps protect the SVT from radiation blasts that can cause p-stop shorts. The chronic radiation dose protection is offered by two mechanisms: hardware and software. The SVTRAD module will trip the beams if the radiation dose rate from the diodes exceeds the "chronic dose rate" threshold defined by the ABORT threshold calibration. This threshold is "averaged" or "formed" on a timescale of seconds (very crude interpretation here) and is therefore higher than the long term SVT radiation dose budget requires to decrease sensitivity to transient events. The softAbort system runs in EPICS and compares 5-minute dose rate averages from the diodes to a more realistic dose rate threshold, typically 30-50 mR/s. If PEP-II delivers radiation doses that are continusously high for more than 5 minutes, the softAbort system will trip the SVTRAD modules, thereby aborting the beams. This system allows the SVT to enforce a 2 MRad/10 yr radiation dose budget that does not inhibit the machine's ability to deal with transient issues on few minute timescales.

autoDetect Automatic Diode Dose Rate Calibration

Due to increased thermal drift in the MID diodes (because of high radiation damage ==> high pedestal currents) and the rate of pedestal increase due to radiation damage, we have designed and installed an automatic diode dose rate calibration system. This EPICS package monitors BBR EPICS and when a suitable NoBeam condition is found, will assert an SVT:DIODE injection inhibit through the BaBar Injection Control SIAM, and zero the diode dose rates for 35 seconds. It will then exit the calibration state and release the injection inhibit. You may interview the system under the **SVT –> Background –> Expert Controls ==> Calibrate Dose Rates –> autoDetect** panel.

The key to this system is that it is automated, and only claims injection inihibit control for 35 seconds. The goal is to help keep the diode dose rates well calibrated by calibrating as often as a NoBeam situation occurs, but "protect" against injection while calibrating by asserting InjDeny. Typically, the system will activate itself 5-15 times per day, depending on the number of noBeam events.

SVT Diode Analysis Tools

The SVT radiation monitoring and protection system (SVTRAD) continuously logs information about instantaneous dose levels, integrated doses, and radiation trips in a set of ASCII text files archived directly by the `svt-mon` IOC. These files also contain information about the temperature near the diodes and the PEP-II beam currents. David Kirkby designed the original skeleton; T.I.Meyer (with some key assitance from Klara Elteto) has signficantly extended the machinery, and is now responsible for its management. The logfiles nominally live at `/nfs/bbr-srv01/u1/babar/boot/iocs/svt-mon/log/bg15/` and `/nfs/bbr-srv01/u1/babar/boot/iocs/svt-mon/log/bg15/archives/`.

8.4.5 Trouble-shooting Hints

Yes, this system is fallible, and as usual, more fallible than its users. Here is a BRIEF listing of common errors and hints about what to do.

- **Background Alarm.** Check the **SVT–>Background** panel for any tell-tale red lights. If the errors are coming from less than all 12 diodes, take a look at the diode specific error summary panel under **SVT–>Background–>Details (right click and drag down) ==> Error Status** for a summary of the diode's alarm conditions. This CAN REALLY HELP.

- **StripChart signals seem to be high and don't come down when beam currents are low or 0.** The strip chart dose rates are probably out of calibration due to radiation damage and electronics drift. Tell MCC that you need to do an SVT diode Monitoring Calibration. If the signals are completely flat-lined, it could be that ADCs are stopped on the module. Check to see the fastHistory buffer is not being rad out, and then check the **Details ==> Readout** panel to see if the

Monitoring field says **Running**. If the signals are flat-lined in MCC but not in BaBar EPICS, the IOC that conencts the two EPICS system is having problems way beyond the scope of SVT EPICS.

- **We're getting way too many SVTRAD trips way too fast.** Probably need to re-calibrate the ABORT thresholds to account for radiation damage and LARGE temperature shifts. Do this by using the SVT ABORT Threshold Re-calibration mechanism. Recently, ask PEP-II to check their vacuum!!

- **We had an SVT trip but there isn't a big spike on the strip charts.** Often, if the radiation blast is too fast, it will be smoothed out in the 4 sample RUNNING average sent to the MCC background panel. Glance at the SVT Monitoring Diode Dose Rates to see if there is a spike there. If that doesn't clue you in, look at the SVTRAD fastHistory Buffer plot. This can help a lot.

- **The SVT radiation doses numbers on the Background panel are red or white in EPICS alarm color.** This means that either the CANbus is belly up or that the ADC configuration for the leakage current digitization is invalid or that the temperature reading used to subtract off the pedestal is out of range. You'll need to page the SVT on-call expert and tell them what you see.

- **The fastHistory plots arrived, but there is no data in them.** Sadly, the decoding and unpacking of the fastHistory buffer is not 100% reliable. This has to do with some "synching" between the `decode` program and the datafile, and it can be fooled by insufficient data or just plain ignorance. Try ONCE more to **Make Plots** but if this doesn't work, you just have to give up. Sorry...

- **One of the ABORT (MID) diodes is continually tripping.** This means that the **ALM** indicator for that MID plane diode is continually RED and will not clear. First check that the module in question is in **Armed** Alarm mode. Do this by using SVT **Background -> Details=>Readout** and check that state of the **Alarm** mode. If it's in **Armed** mode, then several other things could be happening, often right after an attempt at the ABORT threshold re-calibration:

  - A recent attempt at ABORT threshold recalibration didn't exit and reset all the modules to ALARM-RUN mode. If you have just run the ABORT threshold re-calibration, wait at least another 5 minutes before deciding that something is wrong. (The ABORT calibration can really take a full 300 seconds!!) If the signal still doesn't clear, try re-running the ABORT threshold calibration.
  - If you haven't done the ABORT threshold calibration recently, perhaps enough damage has accrued to drive the pedestal over threshold. Try an ABORT threshold re-calibration. If that doesn't help, try **BaBar EPICS** –> **SVT** –> **Background** and right click on **Details** and select **Readout** and look at the status of **CH-0** in the ALARM section of the panel. Are both the Diode and Thermistor inputs okay?
  - If the diode is reporting a DIODE_WATCHDOG alarm, then wait 30 seconds to see if the alarm sticks around, and then try re-running the ABORT threshold

calibration procedure. We have observed a glitch in the channel configuration that can give rise to a false diode disconnect alarm several hours after an ABORT threshold calibration is applied.

- **Anything that is impossible to understand.** Page the SVT commissioner ASAP.

8.5 The BaBar Solenoid

The BaBar Solenoid and its associated Bucking Coil are operated by the Cryo-techs. You must contact them if you need to change the state of the magnet. If PEPII is running, MCC *must* be consulted before making any changes.

8.6 Controlling the IR2 Temperature

The aim is to have a constant temperature (about 20 C) in the IR2 IP region. This will not in general be possible. When the IP temperature is below 25 C, aim for a constant temperature. When the IP temperature is higher, aim for minimizing it. You can get the IP temperature from the"Weather Station" EPICS panel.

The air flows from various entry points in the assembly area (specifically the big roll-up door when it is open) over the top of the shield wall, across the detector and out the roof. During the cool season, when temperatures are generally low, it is sufficient to leave the door closed. During the warm season the roll-up door should be opened and closed to try to minimize the IP temperature. The EPICS weather display shows temperatures in the IP, on top of the electronics house, on the floor of the assembly area (620 floor), and outside. The other input for your decision making is the local weather report (www.weather.com is one place to get this). A final restriction is that you don't want the floor temperature to go much below 10 C because of uncertainties about its affect on the SVT chillers. Generally speaking, if the temperature on top of the electronics house is more than a few degrees warmer than outside, it will be advantageous to open the door. In the afternoon on hot days, when the door is closed, the temperature on top of the electronics house will be rising and the outside temperature will be falling. Open the door when the outside temperature falls to 2 C below the temperature on top of the electronics house.

The door may be left open all night unless the outside temperature drops below 11 C. The door should be closed to about 1 meter when the sun rises in the morning to keep it from shining in. It may be left that way all day if the outside temperature does not rise above 25 C.

The door is controlled by a three-button panel to the left of the door when you are in the hall.

Note the opening and closing in the logbook.

Chapter 9

Using the IR-2 Phone System

9.1 Introduction

The special phone system at IR-2 has been established to cover all of building 621 (Control Room and the upstairs Test Bench area) and parts of 620 (the High Bay, including the Electronics House and the Detector itself). While there are other phones in the area, they are less likely to be used by BaBar physicists.

This system attempts to solve the problem of providing a single incoming main number which serves an extended area. At any given time there may be as few as two people or far too many people in the general area. During routine and stable operation, there are two or three BaBar physicists on shift. They will may rove about the IR-2 environment to fulfill their shiftly duties, yet it is important that they not miss incoming calls. As the number of people at IR-2 grows, so does the probability that the wrong person will answer a given call. These and other scenarios motivated a design with the following characteristics.

- A single "main" incoming number for all of IR-2
- Ability to hear the main number ring from any IR-2 location
- Ability to answer the main number from any phone
- Ability to page a person
- Ability to transfer an incoming call from one phone (where it was answered) to another
- Sufficient phones for outgoing calls
- Minimize the time intervals in which the main number is "busy"

9.2 Phone Operation

9.2.1 How to call IR-2

The main number to IR-2 is extension *5255*, or from off-site, +1-650-926-5255.

Alternatively, if you happen to know that the person to whom you wish to speak is near a particular phone, you may call that number directly. (Presumably, that person has recently told you of this fact.)

9.2.2 How to answer the phone

Pick up the handset to any phone and press the programmed button labeled “answer” (or enter 6363). This will connect you to the main incoming number.

9.2.3 How to park a call

Parking a call is essentially putting someone on hold. While you are connected to the calling party, press the programmed button labeled, for example, ”Park 5255”, **wait for the phone to finish dialing, (or enter “flash” followed by 63671-5255), then hang up the phone for at least 2 seconds (or you will be reconnected to the parked call).**

Note that we have three distinct call park numbers programmed into the phones: “Park 5255”; “Park 5256”; and “Park 5257”. Use “Park 5255” unless you get a busy signal, then try “Park 5256”, etc. Be sure to let whoever is to Unpark the call know *which* park line was used – or they may unpark the wrong call!

Also note that if a parked call is not retrieved within a few minutes, then the caller will be returned to the telephone which originally parked the call.

9.2.4 How to page someone on the PA system

Starting with a dial tone, press the programmed button labeled “page” (or enter 164) and speak your message in a slow, clear voice. For example, “Stew Smith, you have a call parked on 5255”. Hang up the receiver (gently) when you are finished.

9.2.5 How to unpark a call

Pick up the handset and press the programmed button labeled, for example, “Unpark 5255” (or enter 63672-5255).

9.2.6 How to get phone problems fixed

If there is a phone malfunction, first be sure that it is not due to the phone itself (try another instrument on the line). For dual line (e.g., the console phones), be sure that none of the conference buttons is pushed. Once you are convinced it is a phone system problem, submit a report via the phone remedy system.

9.2.7 In case of central phone switch outage

On rare occasions, there is an outage of the central SLAC phone switch. In this case, use the direct outside line *650-854-3120.* The phone connected to this number is in the corner of the console in the control room.

9.3 Telephone and Extension Locations

Note that for emergencies we have a direct outside line: 650-854-3120. The phone is hidden in the corner of the console under the big monitor.

- **Telephones in the BABAR pick up group (can answer the Main Number)**

phone extension	*Bldg/Floor*	*location*	*comment*
5255			main number, 6 ringers
5256	621/1	Cntl Rm, Pilot	dual line phone
5257	621/1	Cntl Rm, other console	dual line phone
5258	621/1	Cntl Rm, center	common line (portable)
5259	621/1	Cntl Rm center	common line
5201	621/1	Cntl Rm, center	common line (portable)
5230	621/1	Cntl Rm, DCH, SVT	common line (portable)
5283	621/1	Cntl Rm, TRG, IFR	common line
5284	621/1	Cntl Rm, ONL	common line (portable)
5297	621/1	Cntl Rm, EMC, DRC	common line
5260	621/1	Alcove	common line
4992	621/1	Conf Rm	common line
4993	621/1	Conf Rm	conference phone
5229	621/1	passage way	FAX
5265	621/2	Center table	common line (portable)
5266	621/2	Center table	common line
5228	621/2	Test Benches	Many extensions
5267	621/2	Kitchen	common line
5274	620-EH/1	Elec House	common line (portable)
5275	620-EH/1	Elec House	common line (portable)
5276	620-EH/2	Elec House Roof	common line
5277	620-Det/2	Top of Detector - west	common line (extension)
5277	620-Det/2	Top of Detector - east	common line (extension)(portable)
5279	620-Det/1	NW corner of detector	common line (extension)
5298	620-Det/1	SE corner of detector	common line (extension)(portable)

- **Other telephones in the area (NOT in the BABAR pick up group)**

phone extension	*Bldg/Floor*	*location*	*comment*
2930	621/2	Office	
5213	621/1	Alcove	modem
5229	621/1	Cntl Rm	fax
164	621/1	Alcove closet	Building page
4075	621/2	Bench	R. Rodriguez
3225	620/1	IP area	common line
3973	620/1	High Bay floor	common line (portable)
8695	624/1	Cryo	common line
8696	624/1	Cryo	common line
3367	636	Gas Shack	common line
8728	PEP adit	PEP-II	near bldg 624
3211	238	Desk	A. Constable
3311	620A	Weld Shop	common line
8799	624/1	PEP-II racks	common line
2464	238	Desk	Z. Vassillian
4671	238	Desk	J. Krebs
854-3120	621	Console	direct line

9.4 Behind the scenes

Special features (and limitations) of SLAC's Northern Telcom SL-1 switch make this system what it is. A few definitions are in order to explain the design.

- Pick up group – a group of phones in which a given phone can answer an incoming call to any of the other phones in the group. This is done by lifting the handset and entering 6363. Note that a particular phone can be a member of at most one pick up group.

- Call Park – transfers an active call to a "holding area". This is accomplished by entering "flash", the number 63671, optionally followed by NNNN, the "park number". Once parked, the line originally answering the incoming call is again free. If a parked call is not "unparked" within 5 minutes, it is returned to the phone that originally answered the call. Only one call may be parked on a given park number at a given time.

- Call Unpark – transfer a call in the "holding area" to a physical telephone. This is accomplished by entering the number 63672 followed by NNNN, the "park number".

- Call Forward - No Answer – Automatically forward an incoming phone call to an alternate number if the call is not picked up within four rings. The number of rings, in this case four, is selectable, but site-wide.

- **Call Forward - Busy – Automatically forward an incoming phone call to an alternate number if the line is busy.**
- **Voice Mail – a system to provide <announcement> or <announcement and message taking> if a call is not answered. At SLAC, this is provided as an optional system to the Northern Telcom switch called "Meridian Mail".**

All phones are in a common pick up group. The main number is not connected to any physical telephones, but only to ringers. When the main number is called, numerous ringers sound until someone responds. As soon as the call is answered by a phone in the pick up group, the main number is again available to accept a new incoming call.

To address the common scenario: answer-hold-page (when you answer the phone intended for someone else), call park is invoked. We have established three distinct "park numbers" to prevent interference during peak usage.

For management sanity, *no* phones have automatic forwarding (busy or no-answer) and no phones have voice mail. One exception is the main number, which will forward no-answer to an announcement-only voice mail giving advice to the caller. No messages are taken, however.

9.5 Reference

- **Telephone Models**
  We currently have six different styles of telephone in the IR-2 area.
  - **Standard Panasonic speaker phone (actually two different styles)**
  - **Panasonic 2-line phone [two phones, both on the BaBar Console]**
  - **Panasonic 900 MHz cordless phones**
  - **Panasonic 2.4 GHz cordless phones**
  - **Plantronics "handsfree" cordless phone**
  - **Speakerphone [one phone in the Meeting Room]**
- **Programmed buttons**

  To make life a little easier, the programmable buttons on most of the IR-2 corded phones have been programmed for common actions.

Button Label	*Program*
Answer	6363
Park 5255	flash 63671-5255
Park 5256	flash 63671-5256
Park 5257	flash 63671-5257
Unpark 5255	63672-5255
Unpark 5256	63672-5256
Unpark 5257	63672-5257
Page	flash 164

Chapter 10

Miscellaneous Procedures

10.1 How to MAKE POPCORN (best method)

This isn't necessary to keep the BaBar running, but it sure tastes great!

1. **Get down popcorn popper, call Tom Himel at x2004**
2. **Plug it into the outlet on the left side of the stove**
3. **Take off glass top**
4. **Pour oil into pan until it is approx. 3mm (1/8 inch) deep**
5. **Pour in popcorn until it just covers the oil**
   (a) **Use a bit less of Orville Redenbacher's brand (the best kind)**
   (b) **Use a bit more of other brands**
6. **Put cover on popper unless you like your popcorn on the floor**
7. **Shake popper when about half of corn is popped**
8. **Unplug the popper when the rate of popping slows so that the mean time between pops is approximately 2.01764 seconds. (Don't let the tails of the binomial distribution fool you.)**
9. **Remove cover**
10. **Take a whiff of the heavenly fragrance**
11. **Carefully salt it**
12. **Clean and put the popper away when you are done with it.**

10.2 How to MAKE POPCORN (inferior method)

This still tastes OK, but . . .

1. **Don't bother to call Tom Himel.**
2. **Put microwave popcorn in the microwave oven.**
3. **Press the "popcorn" button.**
4. **Remove the popcorn when the rate of popping slows so that the mean time between pops is approximately 2.01764 seconds.**

10.3 How to make Espresso

1. **Walk upstairs from IR2 and go into the kitchen.**
2. **Find the Saeco Espresso machine. (It's the big black thing on the table across from the door.)**
3. **Take a cup from the pile next to the machine.**
   - **If there are no cups, look in the box under the table.**
   - **If there is no box, call Kazuko Onaga (x4625) and ask for some.**
4. **Place the cup under the spout.**
5. **Push one of the three buttons to choose the amount of coffee you want.**
   - **The top button is for a tall coffee, similar to an Americano.**
   - **The middle button is for a regular coffee, similar to the output of a steam pressure type espresso maker, or a stovetop Moka.**
   - **The bottom button is for a short coffee, or ristretto. This is like a standard short espresso from your favorite coffee house.**
6. **Drop 25 cents into the coin box.**
7. **Drink, feel the caffeine running through your veins.**

10.3.1 Troubleshooting

Problem: How do we do decaf coffee?

Resolution: On the front of the machine, to the right of the tall coffee button, is a button with a little scoop. This activates the bypass mechanism of the machine. Place 2 Tablespoons of *ground* decaf in the machine, press this button, and then press the cup size button you want.

Problem: The machine is out of coffee, and I don't know where it's kept.

Resolution: The coffee is in the bottom of the freezer, in a big brown bag.

Problem: We're actually out of coffee.

Resolution: There should be a notice posted by the coffee machine saying who the contact person is. Send email to that person; nothing will probably happen until the next day.

Problem: There's a red light on the front of the machine!

Resolution: There are several lights that can be red. If it's the one with an icon that looks like a drop of water, fill the water tank (lift the tank out and fill it at the sink). If it's the one with a coffee bean, add coffee beans. If it's the one with a set of dark blobs, empty the grounds container. If it's the one with a strange, unknowable symbol, the machine is telling you that it needs descaling.

Problem: The machine says it needs descaling!

Resolution: No it doesn't. It is descaled once a month.

10.3.2 Trivia

For those who wish to know, the coffee is purchased under arrangement with Nick Chaput at Dana Street Roasting Company in Mountain View. Their telephone number is (650) 390-9638. The roaster's name is Aaron.

Chapter 11

Workstation Usage Policy

11.1 Environment

11.1.1 Control Room (first floor, bldg. 621).

The Control Room has a Console full of workstations, and a common work area also containing workstations. The Console can hold fifteen "console" machines, but only four people can work on them simultaneously. The rest of the Control Room (including a small alcove on the west end) contains workstation tables with workstations. There are thirteen (13) "development" workstations, which are intended for detector investigations and problem resolution. Also in the Control Room are printer, copier and fax machines.

11.1.2 Test Bench area (second floor, bldg 621)

This area houses subsystem electronics test areas consisting of: a workbench, table, stool, electronics rack, two cabinets and utilities. Other equipment for these test bench areas, such as workstations, is the responsibility of the subsystem. This area is supervised by Ray Rodriguez; contact him for special needs.

11.1.3 Electronics House.

There are three "development" workstations in the EH.

11.2 Workstation Usage Policy

1. Computer equipment in the Control Room Console is reserved for use by official shift personnel for detector operation and display of critical information. If idle, this equipment may be used by a BABAR collaborator

at the discretion of the Shift Operator, Run Coordinator, or Operations Manager, or their deputies.

2. **Computer equipment in the Control Room Common Work Area (including the alcove) and the three machines in the EH are for the following uses (in priority order):**

   (a) **Work necessary to BABAR operations. This work is done at the express request of the shift personnel, Run Coordinator, or Operations Manager. These people are empowered to reassign machines as necessary.**

   (b) **System work for which proximity to the detector is necessary. The shift personnel, Run Coordinator, or Operations Manager are empowered to ration these machine resources to ensure fair distribution. Currently each system is given priority on a particular workstation. These machines are labeled.**

   (c) **System work for which proximity to the detector is desirable. The shift personnel, Run Coordinator, or Operations Manager are empowered to ration these machine resources to ensure fair distribution. In addition, other detector system personnel may challenge such usage if they perceive an unfair proportion of use.**

   (d) **Other BABAR collaborator usage (at the discretion of shift personnel, Run Coordinator, or Operations Manager).**

3. **Computer equipment in the 2nd floor Test Bench Area is "owned" by the detector subsystems and reserved for their exclusive use unless permission is granted to others.**

11.3 Other Guidelines

1. **The development workstations must NOT become an integral part of the working BABAR detector (e.g. they must not run critical server processes) for which other, more reliable machines will be provided.**

2. **Do not use the IR-2 workstations for casual work which may be done in your office.**

3. **Do not leave an IR-2 development workstation unattended (except as noted below) or it automatically becomes subject to reuse by another person.**

4. **If, during the course of appropriate IR-2 work, it becomes necessary to briefly leave a workstation unattended, you may keep possession of the workstation for a short period of time by leaving a post-it note on the workstation screen with your name, activity, your location, the date and time. Remove the label when you are done. If, one hour after the time**

on the post-it the workstation is still unattended, it will become subject to reuse.

(a) It is unacceptable to leave an open-ended note declaring possession of an unattended development workstation.

(b) It is unacceptable to lock the screen of any development workstation except during brief periods as outlined above.

Part III

HOW TO ...

1. Run a test
2. Fix a problem
3. Replace equipment
4. Run a program/subroutine

Chapter 12

Experts

12.1 How to CALL a BaBar EXPERT

If a system has a problem which you cannot figure out... Call the expert!

First call the appropriate system expert on-call. These people carry pagers and cell phones (the pagers are more reliable). They will in turn contact the appropriate expert. If this fails, try to get hold of the System Contact. If this fails, contact the appropriate expert from the following lists directly.

The primary means of contact is via the contacts web page http://bbr-onlwww.slac.stanford.edu:8080/IR2ContactDB/page.php. If this fails first ry a direct telephone page. Note: the pagers are less than 100 percent reliable. If you do not receive a reply to a page in ten minutes, try calling a cell phone number, and then an office or home phone number.

If you cannot get hold of the people listed below, contact the Run Coordinator on-call. The pager for the on-call Run Coordinator is 849-9172. The Run Coordinators' cell phone numbers are listed on the white board in IR2. (The cell phones do not work in IR2 or building 280, but the run coordinator is supposed to forward calls appropriately). The Run Coordinator on-call-schedule is indicated on the white board in IR2 and may also be found on the Run Coordination page, which can be reached from the Operations web page. If you can't reach a Run Coordinator or Deputy, call the Operations Manager, currently Walt Innes, (x2653, pager 997-7224, home 408 733-9351).

If you need to contact someone who has a pager, but don't wish to disturb them too much, the alphanumeric page function can help. You may send an alphanumeric message to them by sending email to
<page number>@myairmail.com Some BaBar members have registered their pagers with the SLAC telalert system. These people may be paged with the unix command
`telalert -i unixid -m "message here"`
or via the telalert web page. Some such people are indicated by having their unixid in the pager field. The script `telamail <mailid> [-s "subject text"] "message text"` may be used to send a message to both email and the corresponding telalert pager.

Other versions of the following lists may be found from the Operations web page.

Check the Contact List or the operations page for the relevant system. Also check the white board in the control room for temporary contact information.

12.2 On-Call System People

System	*Cell Phone*	*Telalert id*	*Pager*
SVT	255-4190	babarsvt	849-9407
DCH	255-4188	babardch	846-0981, 255-4188c
DRC	387-8437	babardrc	846-0545
EMC	255-4189	babaremc	849-9105
IFR	255-4191	babarifr	849-9117
LST	353-1272	babarlst	846-9940
TRG		babartrg	849-9647
DAQ		babardaq	849-2906
ODF		babarodf	849-9474
ODB			849-9102
ORC		babarorc	846-0876
ODC		babarodc	
OEP		babaroep	849-2948
Online			849-9616
Solenoid			846-9907 846-9908
Bucking Coil	call x2180 or MCC x2151		
Liaison	x5121		846-9942

12.3 System Operations Managers and Other Contacts

System	*Name*	*Phone*	*Cell/Page*	*home/inst.(i)*
SVT	Yanyan Gao	4289	255-4190c, 849-9407(p)	(443)825-5493 (c)
	Diego Milanés	8588	255-4190c, 849-9407(p)	(650)329-8671 (h)
	Riccardo Cenci	2607	644-5560c, 846-0334(p)	(650)329-9201 (h)
DCH	Manuel Franco	4099	846-0981(p), (-6c50) 255-4188(c)	
	Michael Kelsey	3525	846-9027(p) (408)-244-9739	
	Vincent Poireau	3596	846-0981(p), +-(c33)450091648	
DRC	Rolf Andreassen	3868		321-1672(h)
	Nicolas Arnaud	4463	(650) 283-6458 (c)	(650) 926-9327 (h)
	Jerome Bequilleux	3313		
	Emmanuel Latour	4976		
	Emmanuele Salvati	4087		(413) 687-1608(c)
	Joe Schwiening	3593	849-9524 (p)	(650) 596-9927
	Jerry Va'vra	2658	846-0631 (p)	(650) 941-1219
	Georges Vasseur			+33-1-6908-3446
EMC	Jennifer Watson	3108	849-9105(p), 255-4189c(c)	
	Jong Yi	3432	849-9671(p)	
	Tim West	3054	996-2685c(p)	
IFR	Henry Band	2655	424-7339(p)	
	Valentina Santoro	3393	849-9117(p), 255-4191c	
	Francesco Renga	4087	849-9117(p), 255-4191c	
LST	Valentina Santoro	3393	846-9940(p), 353-1272c	
	Francesco Renga	4087	846-9940(p), 353-1272c	
	Martin Nagel	2648	846-9940(p), 353-1272c	
TRG	Debbie Bard	3414	849-9647(p)	
	Su Dong	2284	849-9643(p)	
	Rainer Bartoldus	4292	714-4944c(c)	
DAQ	Viola Sordini	2044	849-2906(p), 353-1271c(c)	
Online Coord.	Steffen Luitz	2822	796-2266(p)	
ODF	Matthew Weaver	2746	849-9474(p), babarodf	
	Chris O'Grady	2510	849-9474(p), babarodf	
OEP	Jim Hamilton	2516	849-2948(p)	
Online Coord.	Steffen Luitz	2822	796-2266(p)	
ODC	Steffen Luitz	2822	796-2266	
	Matthias Wittgen	3912	743-7068	
ORC	Boda Franek	5125	846-0876(p)	44 7968 665 778c
CMP INF	Matthias Wittgen	3912	743-7068c	
	Steffen Luitz	2822	796-2266c	
HALL	Walt Innes	2653	997-7224	408 733-9351

12.4 SVT Experts

Category	*Name*	*Phone*	*Page/Cell*	*home/inst.(i)*
Expert on-call	First		849-9407p	
			255-4190c	
	Second		849-9575p	
Operation Manager	Yanyan Gao	4289		(443) 825-5493
	Diego Milanés	8588		(650) 329-8671 (h)
Operation Coordinator	Riccardo Cenci	2607	846-0334p	(650) 329-9201 (h)
			(650) 644-5560 (c)	(+39) 348-735-6013 (c)
Front-End Electronics	Giovanni Calderini	2044	(+39) 3204218418 (c)	
DataFlow	Amedeo Perazzo	5147	(650)533-1506 (c)	
Power Supplies	Gabriele Simi	3402		301-405-6070 (i)
Calibration	Elisa Manoni	8568		(+39) 0755852796 (i)
Radiation	Emilie Martin	8610	846-0842p	949-400-1166(h)
	Shane Curry	8610	248-7161c	
Detector Monitoring	Brian Petersen	2889		650-321-8540(h)
Chiller	Roy Kerth			(925)254-0770(h)
				(510)486-6662(i)
Data Transm.	Joel Martinez	4750		(650)854-4364(h)
OEP and FastMonitoring	Al Eisner	2018	846-9940	650-364-3686
Automated Fast Monitoring	Joe Tuggle	2406	(650) 269-8831 (c)	(650) 386-6585 (h)

12.5 DCH Experts

Category	*Name*	*Phone*	*Page/Cell*	*home/Inst.*
DCH Contact	Manuel Franco	4099	846-0981, 255-4188c	
	Mike Kelsey	3525	570-9027 (408)-244-9739c	
Gas System	Vincent Poireau	3596	846-0981, 3-3c450091648	
	Jim McDonald	3644	377-6840, 823-2524c	
	Karl Bouldin	2589	377-9625, 823-2524c	
Chiller	Jim McDonald24082	3644	846-6840, 823-2524c	
	Karl Bouldin	2589	377-2625, 823-2524c	
HV hard/software	Karl Bouldin	2589	377-2625, 823-2524c	
Electronics - LV	Operations Manager	3598	846-0981, 255-4188c	
Safety	Christopher Hearty	(604)822-9163 4799	(604)377-2815c	(604)517-1513
	Mike Kelsey	3525	570-9027 (408)-244-9739c	
Env. Monit.	Karl Bouldin	2589	377-9625, 823-2524c	
OEP, Event Display	Mike Kelsey	3525	570-9027 (408)-244-9739c	
Fast Monit.	Operations Manager	3598	846-0981, 255-4188c	
	Karl Bouldin	2589	377-9625, 823-2524c	
Calibration	Mike Kelsey	3525	570-9027 (408)-244-9739c	
	Gabriella Sciolla	(617)258-0541 2701		(781)863-0013

12.6 DRC Experts

Category	*Name*	*Phone*	*Page/Cell*	*Other phone contact*
Oncall expert			846-0545 (pager) 387-8437 (cell)	
Backup expert			849-9297 (pager)	
System Managers	Joe Schwiening (SLAC)	3593		596-9927(h)
	Nicolas Arnaud (LAL-Orsay)	4463	283-6458(c)	926-9327(h)
Contacts	Jose Benitez	3362	283-2627(c)	625-1523(h)
	Jennifer Prendki	2044	(c)	(h)
Electronics	Nicolas Arnaud	4463	283-6458(c)	926-9327(h)
Fast Monit.	Loic Esteve			
	Nicolas Arnaud	4463	283-6458(c)	926-9327(h)
Prompt Reco	Nicolas Arnaud	4463	283-6458(c)	926-9327(h)
	Georges Vasseur			+33 (1) 6908-3446
HV	Nicolas Arnaud	4463	283-6458(c)	926-9327(h)
Water and Gas	Matt McCulloch	3288	849-9626	494-8752(h)
	Tom Weber *(last SLAC contact)*	4146		(408) 252-4674(h)
	Steve Dardin (LBNL)		510 448-6070c	(510) 486-6598 (i) (510) 704-4426(h)
	Jerry Va'vra (phys)	2658	846-0631	941-1219
Environment	Nicolas Arnaud	4463	283-6458(c)	926-9327(h)
Mechanical	Matt McCulloch	3288	849-9626	494-8752(h)
	Jerry Va'vra (phys)	2658	846-0631 (p)	941-1219
Backgrounds	Nicolas Arnaud (sclrs)	4463	283-6458(c)	926-9327(h)
	Jerry Va'vra (Xtals)	2658	846-0631	941-1219
chillers	SEM/HVAC group			see section 12.14

12.7 EMC Experts

Category	*Name*	Phone	*Page/Cell*	*home/inst.(i)*
Expert on-call/ Commissioner	Chris West	3434	849-9105 p 255-4189c(c)	
Electronics	expert on-call		849-9671	
	Jong Yi	3432		
	Tim West	3054		
	Graham Jackson	3054		
Monitoring	expert on-call		849-9105	
	Jong Yi	3432		
	Tom Meyer	4244		650 838-0881
Source Calib.	expert on-call		849-9103	
	Chris West	3434		
	Andy Ruland	2449		
	Bill Wisniewski (hrdwr)	4890	*849-9661*	952-9876
	Dieter Walz (fluid)	2786	571-3270	
Light Pulser	Wolfgang Gradl	8521		
	Moritz Karbach	8988		
Cooling	Bill Wisniewski	4890	849-9661	952-9876
	Rafe Schindler	3450		
	Zorb Vassilian	2464	849-9463	
	Eric Doyle	2861	424-7993	
OEP	expert on-call		849-9105	
General software	Helmut Marsiske	4333		650-592-5482
Barrel Mech.	expert on-call		849-9661	
	Bill Wisniewski	4890	849-9661	952-9876
	Rafe Schindler	3450		
Endcap Mech.	Stuart Metcalfe	8694		
	John Fry	2468		

12.8 RPC Experts

Category	*Name*	*Phone*	*Page/Cell*
Expert on call			849-9117
RPC Contact	Henry Band	2655	(510) 825-5865
	Valentina Santoro	3393	849-9117, 255-4191c
	Francesco Renga	4087	849-9117, 255-4191c
ODC	Nick Sinev	2970	(650) 207-6057
Cylindrical RPC	David Lange	8513	925-423-7705 02031
Gas system	Doug Wright	8513	(888) 500-4439
	Stephen Foulkes	5454	849-9118
	David Lange	8513	925-423-7705 02031
DAQ	Enrico Robutti	5359	
Cooling	Henry Band	2655	(510) 825-5865

12.9 LST Experts

Category	*Name*	*Phone*	*Page/Cell*
Expert on call			846-9940, 353-1272c
LST Contact	Valentina Santoro	3393	846-9940, 353-1272c
	Francesco Renga	4087	846-9940, 353-1272c
	Martin Nagel	2648	846-9940, 353-1272c
	Mark Convery	8577	703-2473c
	Stew Smith	4775	
	Roberto Calabrese	3393	
	Charlie Young	2669	255-4202c
Gas system	Bob Messner	2933	849-9547
DAQ	Enrico Robutti	5359	

12.10 TRG Experts

Category	*Name*	*Phone*	*Page/Cell*
TRG Contact	On-call Expert		849-9647
	Debbie Bard	3414	849-9647
	Su Dong	2284	849-9643
DCZ	Su Dong	2284	849-9643
	Jamie Boyd	3761	
	Masahiro Morii	3257	
EMT	Mark Tibbetts	2767	804-1601c
IFT	Davide Piccolo		+39-081-676177 (Italy)
GLT	Su Dong	2284	849-9643
L3	Rainer Bartoldus	4292	714-4944c
	Prafulla Behera	4089	940-8508
	Jim Panetta	2995	849-9673

12.11 Central System Experts

Category	*Name*	*Phone*	*Page/Cell*	*home/inst.(i)*
Lead Elec. Tech.	Ray Rodriguez	4075	849-9562	831 636-9520
BCS	Ray Rodriguez	4075	849-9562	831 636-9520
	Walt Innes	2653	997-7224	408 733-9351
EH	Ray Rodriguez	4075	849-9562	831 636-9520
	Michael Przybylski	8545	424-7635	
	Walt Innes	2653	997-7224	408 733-9351
DFL (FCTS, ROMs, ...)	Ray Rodriguez	4075	849-9562	831 636-9520
	Michael Przybylski	8545	424-7635	
	Chris O'Grady	2510	849-9474(p)	
	Gunther Haller	4257		
VME Crates	Ray Rodriguez	4075	849-9562	831 636-9520
	Gunther Haller	4257		
ODC	Matthias Wittgen	3912	743-7068	
	Steffen Luitz	2822	796-2266	
	Walt Innes	2653	997-7224	408 733-9351
Power Supplies	Ray Rodriguez	4075	849-9562	831 636-9520
	Michael Przybylski	8545	424-7635	
	Gunther Haller	4257		
VSAM	Ray Rodriguez	4075	849-9562	831 636-9520
	Michael Przybylski	8545	424-7635	
SIAM	Ray Rodriguez	4075	849-9562	
	Michael Przybylski	8545	424-7635	
Spares	Ray Rodriguez	4075	849-9562wo	831 636-9520
	Michael Przybylski	8545	424-7635	
IR2 Hall	Zorb Vassilian	2464	215-3390cc	
	James Krebs	4671	849-9425	
	Walt Innes	2653	997-7224	408 733-9351

wo → work only

12.12 Online and DAQ Experts

Category	*Name*	*Phone*	*Page/Cell*
Online Contacts	Steffen Luitz	2822	796-2266(p)
DAQ	Viola Sordini	2044	849-2906(p)
Dataflow	expert on-call		849-9474(p),babarodf
	Chris O'Grady	2510	
	Matt Weaver	2746	
OEP	Jim Hamilton	2516	849-2948(p), babaroep
Calibration	Matt Weaver	2746	
L3 Trigger	Rainer Bartoldus	4292	714-4944c
Run Control	expert on-call		babarorc
	Boda Franek	5125	011 (44 1235) 445643 (i)
Database	Andy Salnikov	5387	849-9102
Logging Manager	Jim Hamilton	2516	849-2948(p)
ODC	Steffen Luitz	2822	796-2266
	Matthias Wittgen	3912	743-7068
EPICS	Matthias Wittgen	3912	743-7068
Infrastructure	expert on-call		see whiteboard
	Matthias Wittgen	3912	743-7068
	Steffen Luitz	2822	796-2266

12.13 Safety People

Category	*Name*	*Phone*	*Page/Cell*
Officer (BaBar)	Frank O'Neill	5300	
Officer (PPA)	Sandy Pierson	2686	424-7654

12.14 How to CALL for SLAC HELP

In case of problems related to infrastructure at PEP IR2 that are not directly BaBar's responsibility, you may need to call for outside help. If it is a local problem, the Hall Manager, Zorb Vassilian (x2464, pager 849-9463), may be most knowledgeable. Outside normal working hours, MCC (2151) will advise you, and tell you who is available. For SLAC infrastructure problems contact the Conventional and Experimental Facilities (CEF) service desk at x8901. The desk is attended 8 AM to 5 PM, workdays. At other times page 846-0751. Service requests may also be submitted via the Web at http://www-internal.slac.stanford.edu/sem/NonSafety/. When accessing the SLAC internal pages you may asked for a userid and password. For userid give "slac windowsuserid" and use your windows password. The web interface my not work with browsers other than Explorer. If you contact the service desk, you should be given a tracking number. Enter it into the elog. For non-emergency problems, use the CEF service desk instead of calling the more specific numbers below.

The cryogenics group is on site from 06:30 to 15:00, Monday through Friday. During these hours (06:30 through 15:00 M-F) there are on-site cryo-techs who will respond to a page. No one will respond to the cryo-techpager after hours. At other times an off-site tech or a cryo-group supervisor will need to be contacted. Page the supervisors in the order that is in the following phone list. In case of problems, the liquid Helium system will automatically page the cryo-people. The IR2 cryo-control room is not usually manned.

Report phone problems via the phone system remedy database at http://www2.slac.stanford.edu/comp/telecom/phone/.

Problems with printers or Windows computers should be reported via the computing helpdesk *Help Track* system. The web entry form is at http://www2.slac.stanford.edu/comp/helptrak/ .

Category	*Name*	*Phone*	*Page/Cell*
AIR CONDITIONING	HVAC group	see HVAC	
AREA MANAGER	Michael Zurawel	4116	846-9838
BUILDING MANAGER	Sandy Pierson	2686	704-2433
CHILLED WATER	HVAC group	see HVAC	
CONFINED SPACE	Joe Kenny	3517	570-8742
CRANE OPERATIONS	Zorb Vassilian	2464	215 3390c
	@home		
CRYOGENICS	Cryo-tech at EFD	5160	846-9907
	Art Candia	2555	424-7851
	@ home	(831) 588 3303	
	Mike Racine	3543	598-8648
	@ home	(510) 226 9138	
	Wes Craddock	2264	424-7216
	@ home	299 0279	
DRC CHILLER	HVAC group	see HVAC	
ELECTRICAL	Wes Craddock	2264	424-7216
	MCC	2151	
EMC CHILLERS	HVAC group	see HVAC	
FIRE ALARMS	Peter Gallego	4013	571-2945
FIRE, EMERGENCY		9 911	
FIRE DEPARTMENT		2776	
FM200 SYSTEM	Peter Gallego	4013	571-2945
HALL MANAGER	Zorb Vassilian	2464	215 3390c
	@home	(408) 735-9435	
HEALTH PHYSICS	Nisy Ipe	4324	849-9513
HVAC group	Noramn Yeung		424-7460
	(after hours) MCC	2151	
MAGNET POWER	Cryo-tech at EFD	5160	846-9907
MCC		2151	283-9700(c)
			424-7846(p)
MEDICAL DEPARTMENT		2281	
PHONE REPAIR		2200	
SECURITY	front gate	2551	
	workday	3646	
SAFETY OFFICE	Joe Kenny	3517	570-8742
CEF		8901	846-0751
UPS	Ron Badger	2757	849-9456
	Wes Craddock	2264	424-7216
VENTILATION	HVAC group	see HVAC	

wo → work only

Chapter 13

How to replace a Module

13.1 ACCESS to spares

Many of the spare modules are kept in the central "golden" spares cabinet. This cabinet is located in the group of cabinets on the floor of the IR2 Hall next to the Electronics House. For access to this cabinet during normal working hours please contact one of the following people.

Name	Ext	Pager	Room/Bldg
Ray Rodriguez	4075	849-9562	203
Walt Innes	2653	997-7224	CL R213
Zorb Vassilian	2464	849-9463	bldg 238

After normal working hours please contact the BaBar Pilot at extension x5256 or page one of the people listed above.

13.2 PROCEDURE

Once access to the cabinet is obtained please follow a few steps in order to help us maintain a reasonably reliable and available set of spares.

- If you find a module that is needed to replace a suspected bad module, note the type and serial number of the module and legibly enter the date and your name in the space provided on the inventory sheet which is attached to the instructions on the spares cabinet.

- When you have identified the bad module, fill out the tag that was attached to the spare module that you removed from the cabinet, now attach this tag to the suspected bad module with a description of where it came from and why it required replacement.

- Enter your actions in the BaBar hardware database and trouble log. You will need to make a location change for each module, and generate a new trouble report.

- Return the bad item to the bottom shelf of the cabinet.
- Close and lock the cabinet and return the key (if you still have it) to the person who gave it to you.
- If there are any problems with the quality, quantity, availability, etc... of the items in this cabinet please contact Ray Rodriguez at x4075 with details.

Chapter 14

Monitor BaBar from afar

Basic status information may be obtained from with a web browser. More detailed and interactive monitoring requires one to logon to a workstation and IR2. To do so requires Secure Shell and an X Windows server program.

14.1 Status, and Electronic Logbook

The current run status and the electronic logbook may be accessed from anywhere using almost any web browser. They may be accessed from the BaBar→Detector→Operations web page.

14.2 Detector Controls Monitoring

You will need an SSH capable terminal emulator program and an X11 Windows server. Use these to login to bbr-dev20 or bbr-dev100 and then follow the instructions in chapter 7 for remote use of dm, alh, ambient explorer, and cmlog.

14.3 Fast Monitoring

Run the shell script

```
/nfs/bbr-srv02/bfdist/Production/bin/SunOS5/RemoteBabarJas
```

This will connect to the JAS data server running in IR-2 and will bring up the Navigator HTML pages.

Note that this will now pick up the "Millennium-2" version of JAS, which is based on Java 1.2.

Note also that there is a known bug in the interaction between Java 1.2 and SSH X-forwarding which will cause display problems if you run JAS on a different machine from the one running your X server. As a very temporary workaround, you can avoid this by issuing the following command before running JAS in this way:

`setenv NO_AWT_MITSHM true`

We expect that a heuristic test for SSH tunnelling, automatically activating this switch, will be included in the JAS script itself in the very near future. We apologize for any inconvenience in the mean time.

Note that the connection will succeed only if the JAS data server is being run by the Navigator shift taker in IR-2. If for any reason the data server is restarted, any instances of JAS being run remotely will be unable to locate histograms and will display error messages. To reconnect to a restarted JAS data server, select `File, Reconnect...`, enter "bbr-srv05" as the server name, click `Next >>`, click on the first row (not the heading row) in the table, and click `Finish`. Select `View, Home` to return to the Navigator HTML home page. If you encounter an error message, chances are the JAS data server is not running; wait a while and try again.

Navigator shift takers should invoke JAS as described in the Live Fast Monitoring shift instructions.

Chapter 15

How to operate POWER SUPPLIES

15.1 SVT CAEN LV Supplies

Information on the SVT CAEN supplies may be found at
.../~babarsvt/psupply/powersupply.html.

15.2 DCH CAEN HV Supply

Information on the DCH CAEN supplies may be found at
.../BFROOT/www/Detector/CentralTracker/operations/survival/index.html#hvpanel.

15.3 DRC CAEN HV Supplies

Information on operating the DRC HV may be found at
Detector/DIRC/Operations/DircHVEpics.

15.4 EMC CAEN Diode Bias Supply

Information on the EMC CAEN supply may be found at
.../BFROOT/www/Detector/Calorimeter/Operations/EMC_System.html#start, and
.../BFROOT/www/Detector/Calorimeter/Operations/EMC_System.html#stop.

15.5 IFR CAEN HV Supplies

Information on operating the IFR HV may be found at
.../BFROOT/www/Detector/IFR/iodc/shifthelp.html#hvpanel.

Chapter 16

Read the UPS history

The Uninterruptable Power Supply is located in the north east corner of the IR-2 Hall. The UPS power is supplied from the batteries via an inverter unless the batteries are dead, in which case the output is connected to the input power. This is called “bypassing”. When a problem on the input power is sensed, the UPS disconnects itself from the input power. It waits until the input power has been OK for about five minute and then re-connects. Meanwhile bypass transfer is said to be unavailable.

The history of UPS problems may be read on its control panel. Have no fear, you may not harm anything without entering the password. Use the buttons on the left (“next” etc.) to scroll through the various status reports. The history is the one that gives a time and a transition. It is usually either next or already displayed. Use the arrow buttons on the right to scroll through the history. Note that the reported times may be off by a few minutes (its MSDOS time).

In the event of a power failure, the UPS is expected to be able to maintain power for 6 hours. An estimate of time remaining may be found on one of the status displays. Note that this estimate is low by a factor of two because it is based on one battery bank, while we have two.

The UPS system power to the EH is interlocked by the VESDA (smoke detector) system. Smoke in the racks or under the floor will cause the UPS to the EH to be shut off. Other than maintenance work, this should be the only cause of loss of UPS power.

Chapter 17

Serial Ports

17.1 Connect to a serial port

Many BaBar devices have serial ports. Some examples are the EPICS IOCS (Motorola single board computers), the CAEN power supplies, and, of course the SUN workstations. Most of these ports have been connected to XYPLEX terminal servers, which are, in turn, connected to the LAN. This allows one to sit at any workstation and connect to the device of interest. To connect to a port, issue the command `xyplex -f portname`. At the time of this writing, the current portnames were:

```
cen-mon
cen-ilk
cen-bip
cen-gms
svt-mon
svt-ilk
svt-lv
svt-caenN N=1-12
dch-mon
dch-hv
dch-gas
drc-mon
drc-hv
drc-gas
drc-caenN N-1-6
emc-mon
emc-ilk
ifr-mon
ifr-caenN N=1-4
odf-svtN-M N=0-4, M=0-3 but not 4-3
odf-dchN-M N=0-1, M=0-3
odf-drcN-M N=0-2, M=0-2
```

```
odf-emcN-M N=0-9, M=0-10
odf-ifr-N N=0-4
odf-ifr-test
odf-dct-N N=0-3
odf-emt-1
odf-glt-0
odf-fcts-N N=0-1
farmN N=00-77
bbr-conN N=09, 11-15
bbr-srvN N=00, 02-04
baydelN N=1-4
tt1-N N=12-16
tt7-N N=06-10, 18, 19
tt10-20
tt15-N N=18-20
tt16-N N=00-20
```

A current list may by obtained by issuing the command `xyplex -i ".*"`.

17.2 Disconnecting from a serial port

To disconnect from a port type `<control>]` . This will bring up a telnet prompt from which you can `quit`.

Chapter 18

Reboot an IOC

The reasons for, and restrictions on, rebooting EPICS IOCs are given in appendix C. There are several ways to actually accomplish a reboot. They are described here in order of decreasing gentleness.

- Use EPICS to issue the reboot command via ethernet. This will only work if the IOC is up and running normally. Go to the CEN→(Detector Control Crates) IOC→ (crate of interest) IOC EPICS screen. This brings up the IOCStats.dl display. Click on Control. Click on Enable and then Sys Reset within ten seconds. Nothing will appear to happen for at least a minute. Some IOCs take as long as five minutes to complete rebooting. Progress so far may be estimated by looking at the logfile. To do so, click on logfile on the IOCstats screen. This presents a static snapshot of the logfile. To update, select "revert to saved" from the file menu.
- Use the Xyplex unit to connect to the serial port. On a con or dev workstation, issue the command `xyplex -f <portname>` (see chapter 17.1). Sometimes the reboot will start as soon as you connect. If not, enter a `ctrl X`. A `ctrl ]` will disconnect you. You must follow this by a `quit` command to exit telnet. You may disconnect as soon as the reboot has started. This is the recommended procedure if there has been an outage of the UPS in EH power zone 1.
- Use the front panel reset button. Go to the physical IOC and press the button on its front panel.
- Cycle the AC power. Turn off the VME crate in which IOC resides, wait 5 seconds, then turn it back on.

Chapter 19

Add a sound to the Alarm Handler

The audiofiles and the tools for dealing with them are in the directory:

`/nfs/bbr-srv01/u1/babar/boot/apps/all/alh/audiofiles/` .

The script for recording them is `pa_record` and the script for playing them is `pa_speak`. The calling sequence may be obtained by executing the commands

`pa_speak help` , and `pa_record help` .

19.1 Invoking sound files

The alarm handler may be configured so that particular alarm transitions cause a pre-recorded sound to be produced by the public address system. This is done by using the script execution option in an alh configuration file. An example from .../cen-mon/alh/eh-mon.alh is

`$SEVRCOMMAND UP_MAJOR ../../all/alh/audiofiles/pa_speak ehves 6`

This executes the script when the group (in this case) state goes from either no alarm or minor alarm to major alarm. The explicit path is probably not necessary. Since this example is used in conjunction with the hardware alarm annunciator, a 6 second delay is needed to allow the door-bell chime to complete. The sound files (in this case `ehves.au`) are in SUN sound file format (`*.au`). `pa_speak` is programmed so that sound will only be generated when run on bbr-con01 by the console user, normally `babar`.

19.2 Recording sound files

The script `pa_record` may be used to generate sound files. There is a microphone connected to bbr-dev116 in the Electronics House for use with `pa_record`. set up your EPICS environment and then change directory to $/DAPPDIR/epics-gen/alh/audio/ first. A tip: don't start speaking until a couple of seconds after hitting the carriage return.

Alto voices are the most intelligible over the PA system followed by soprano, tenor, and bass in that order. Using a distinctive voice associated with the system may be helpful.

Chapter 20

Procedures for the Backup Cooling System

H. Shin, January 24, 2003 (Rev 25, February 18, 2004)

20.1 General

The Backup Cooling System (BCS) is designed to provide an alternate cooling system if a primary system fails. The BCS contains an LCW cooling system as well as a Fluorinert cooling system. The LCW system can be configured to supply cooling to the Drift Chamber at sub-atmospheric pressure.

Only individuals who have been instructed and checked out in operation of the BCS system may use this procedure. Also a system person must be present. This may be the same person.

Careful adherence to the following procedures is needed to prevent inadvertent loss of cooling fluid and/or system damage.

This procedure covers cooling arrangements for the B-Cal (aka EMC Barrel), DIRC, and DCH LCW cooling, as well as for the B-Cal and F-CAL (aka EMC End Cap) Fluorinert cooling.

The flow meter readouts are only available via EPICS. It is helpful to have a laptop with EPICS running on the BCS platform.

There is some redundancy in the valve system. Except in unusual circumstances, V1, V3, V26, V27, V30, V31, and V41 should be open. V40 should be closed.

20.2 Specifications

The following are the cooling specifications for the primary systems.

System	Fluid	Load, KW	Flow gpm	Setpoint C	Pressure psig
B-Cal	LCW	8	57	16.7	50
DIRC	LCW	4.2	4.8	15	50
DCH	LCW	2	8	17.5	-7.5 (-15 in Hg)
B-Cal	Flnrt	1.12	25	19	41
F-CAL	Flnrt	2.31	6	4.5	55

20.3 Primary System Shutdown

The primary systems may be shut down for maintenance or as a result of system component failure (e.g., pump failure, leak, etc.). Isolate the system by 1) shut off the circulating pump, 2) shut off the supply isolation valve then, 3) shut off the return isolation valve. In many cases, it is not actually necessary to shut down the primary system, they may be put into local bypass mode instead.

NB: Prior to using the BCS, make sure the detector system has no leaks by referring to the primary system reservoir to account for fluid capacity.

20.4 Backup Cooling System Activation

There are three different BCS modes for the five primary systems; positive pressure LCW, sub-atmospheric pressure LCW, and Fluorinert. Refer to the specification table for specific temperature setpoints, VFD setpoints, pressures and flows. *Note - the temperature setpoint of the BCS may need to be adjusted after connection to the detector to meet operational requirements.*

The BCS will not back-up the Fluorinert system if the Spare Fluorinert chiller is in use.

The DRC and DCH systems normally are filled with domestic water, not LCW. The BCS LCW may be connected to these systems, but after normal operation is restored, the BCS shall be drained and re-filled with clean LCW for subsequent use.

All of the BCS valves have assigned valve numbers. See drawings PF-350-911-40, GP-350-911-41 and GP-350-911-42 for the BCS schematic valve numbering. The valves are also numbered on the valve panels and on the BCS assembly. An “open” ball valve will have its handle in-line with the valve body.

Normal operating condition valve positions are shown in Figures 1, 2, 3 and 4. Figure 5 is a schematic of the entire system showing the function of all the valves.

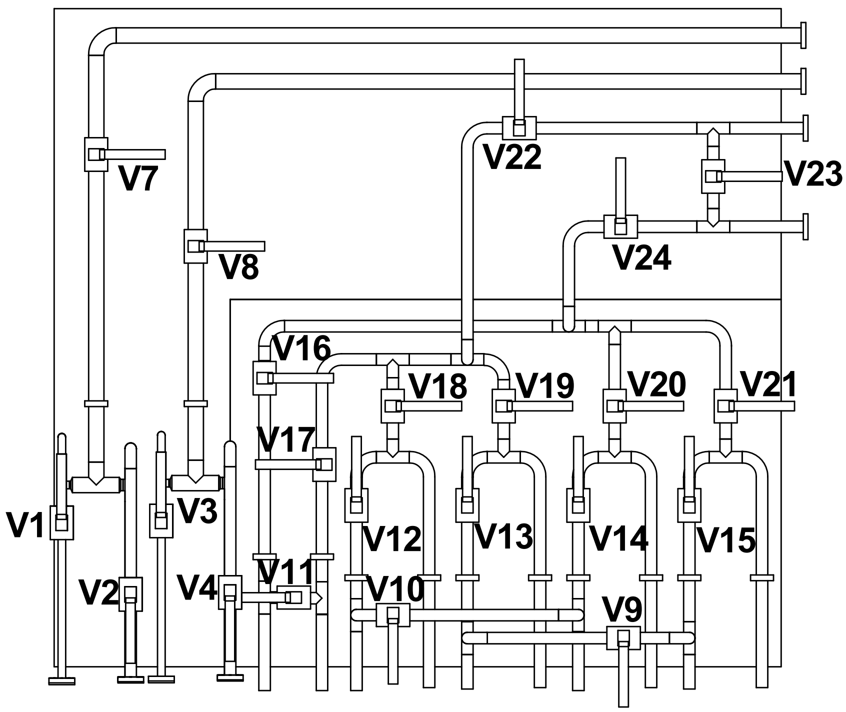


Figure 20.1: Fluorinert Panel

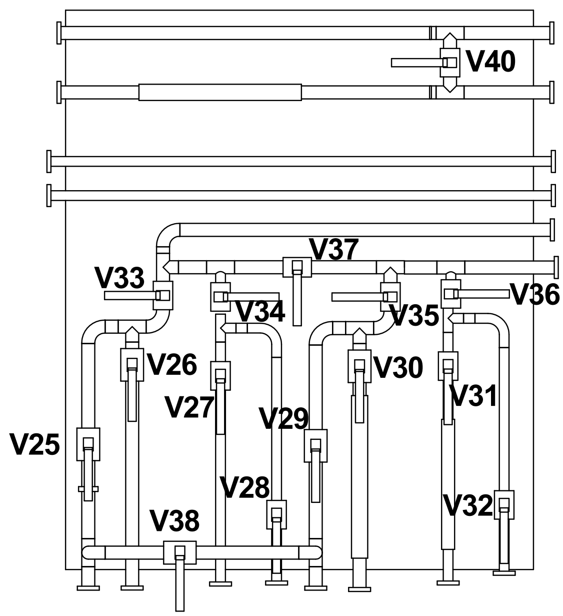


Figure 20.2: Low Conductivity Water Panel

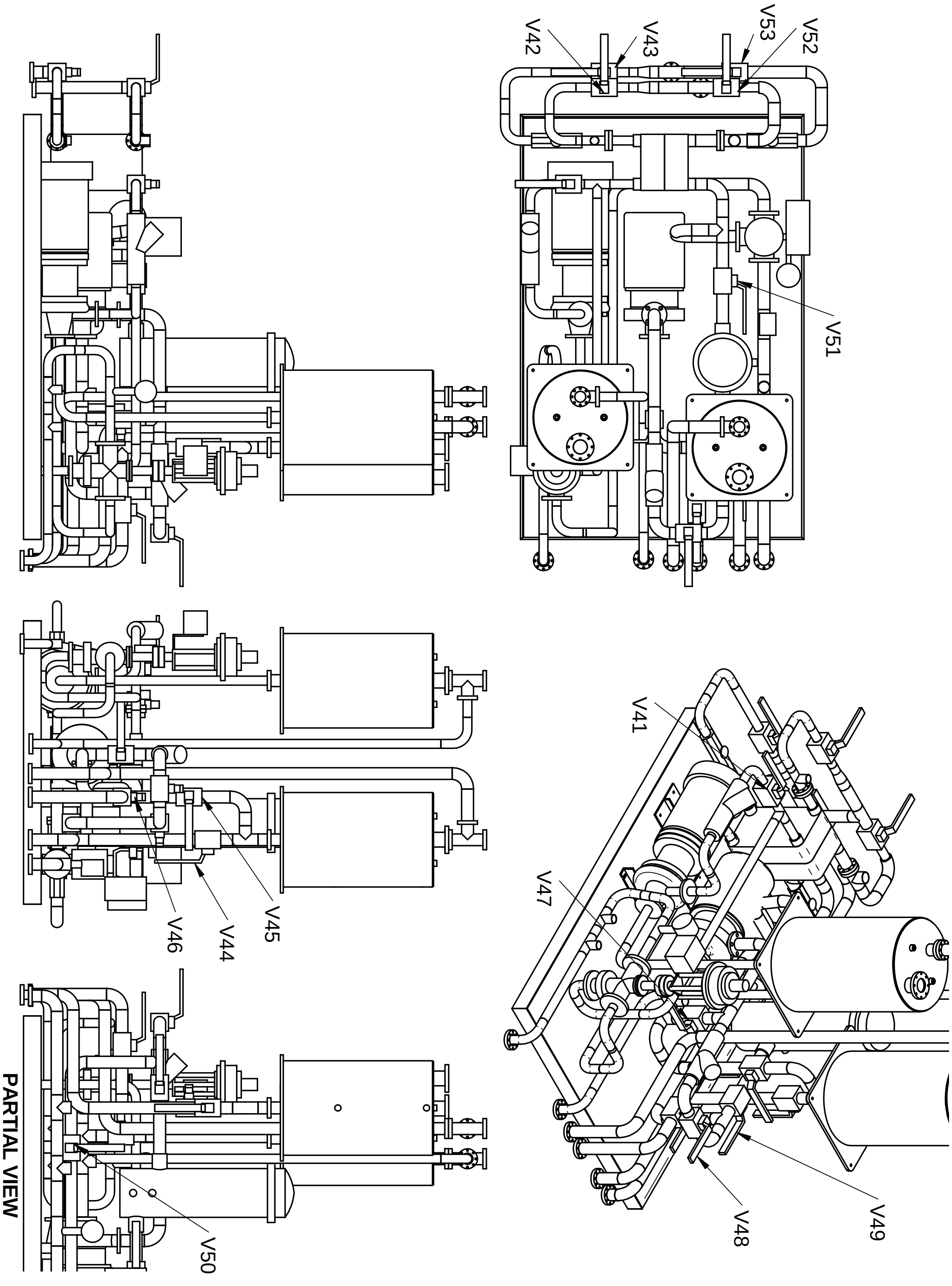


Figure 20.3: BCS Proper

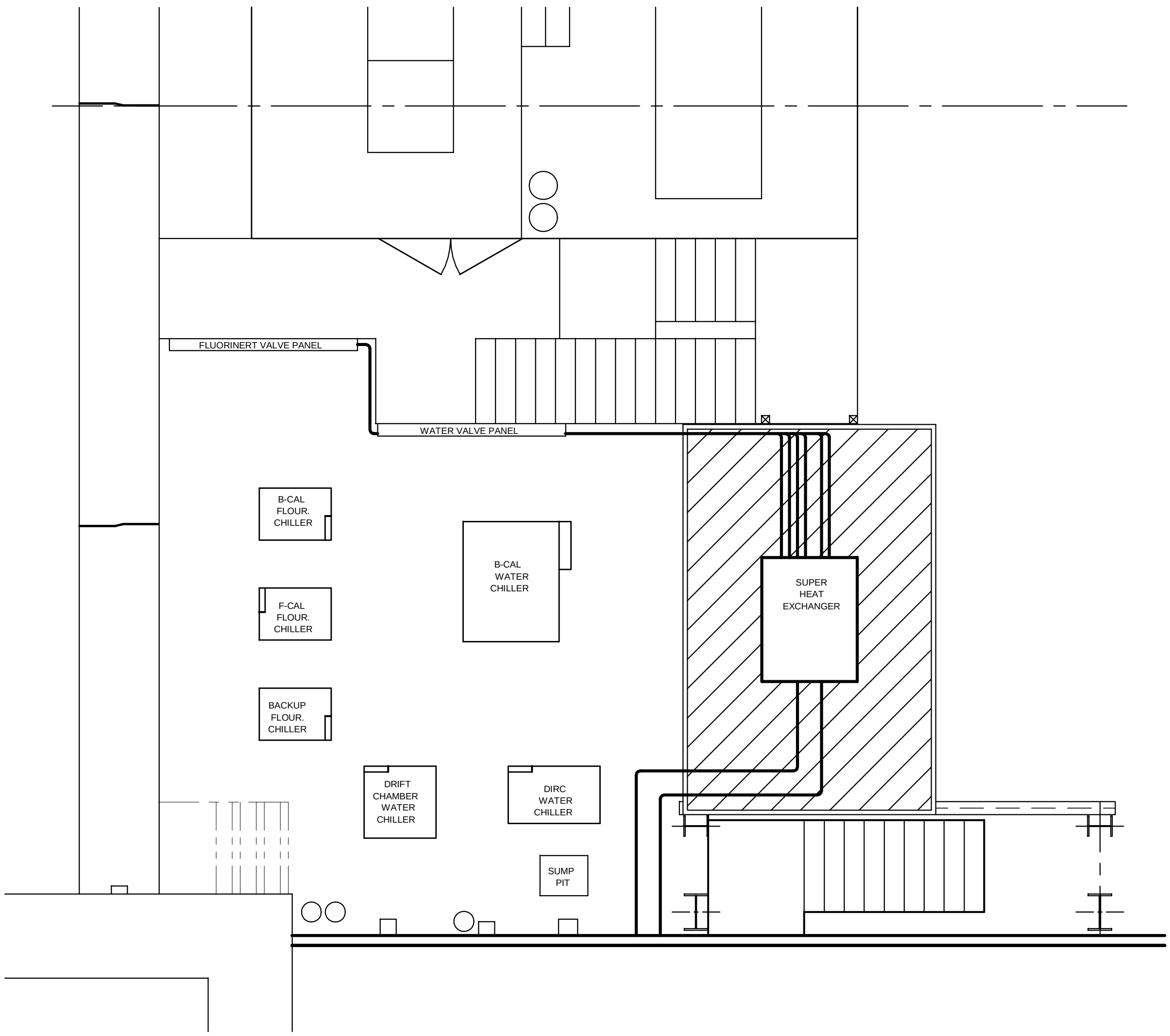


Figure 20.4: Hall Plan

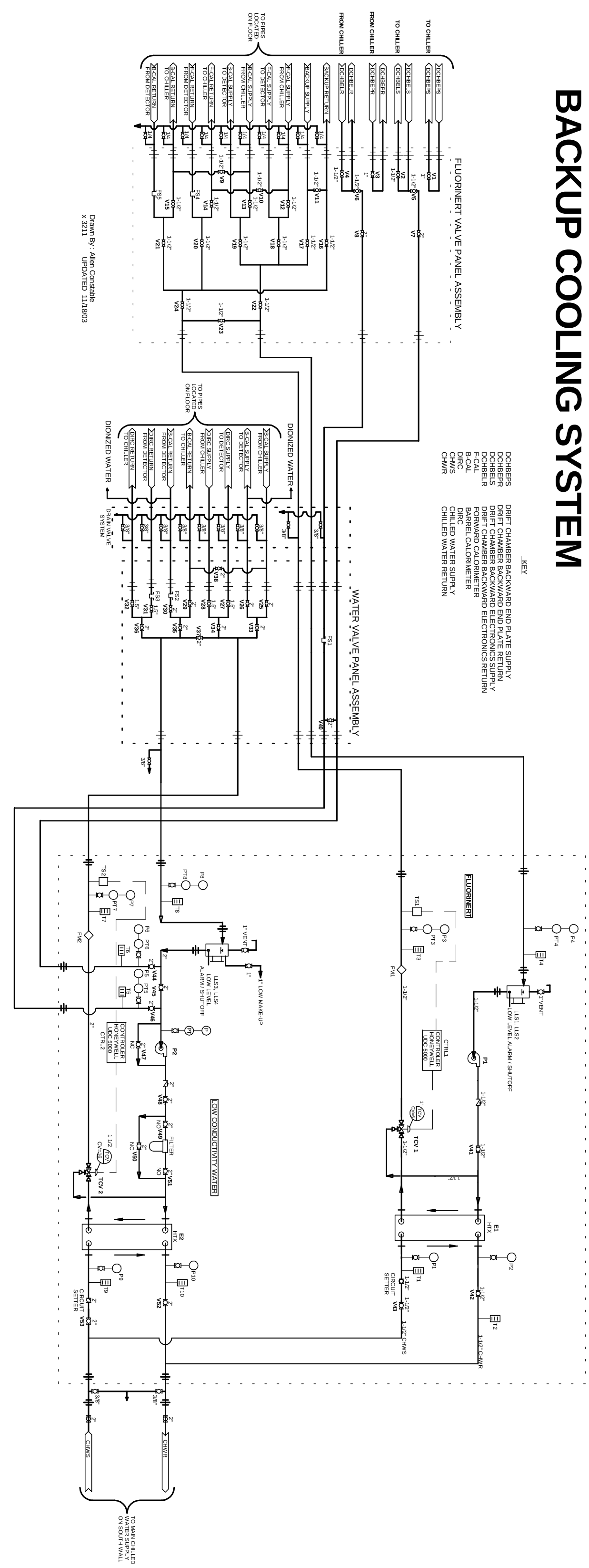


Figure 20.5: BCS Schematic

20.5 Positive Pressure LCW for EMC B-CAL

20.5.1 Transfer to BCS Operation

1. *Bring up EPICS panel.* Start EPICS on either a laptop or an EH workstation. Go to the display odc_main → cen → cooling → BCS → LCW EMC/DRC.

2. *Turn on the chilled water to the heat exchanger.* Open chilled water valves V52 and V53.

3. *Configure the water valve panel* - Verify that V33, V34, V35 and V36 are closed and that V37 is open.

4. *Configure the BCS* - Verify that V44, V46, V47 and V50 are closed and that V45, V48, V49, and V51 are open. Open the vent valve and the valve to the pressure relief valve. Check the LCW reservoir level, fill if necessary.

5. *Configure the main control panel* - Use the arrow keys on the controller keypad to set the temperature (SP) on the LCW controller to 16.7 C. The LCW EMC flow-switch must be set to "By-passed" (Red LED "on"). The other such switches must be in the middle position. Make sure the reservoir level is sufficient (Green LED "on"). Check that the control switch (just to the right of the controller unit) to the "Off" position.

6. *Start the BCS* - Find the motor starter box on the LCW side of the BCS. Set the Hand-Off-Auto switch to the "Off" position, move disconnect switch lever on the right side of the motor starter to the "On" (up) position, then turn the Hand-Off-Auto switch to the "Auto" position. Back on the main control panel, turn the control switch to the "On" position. The Variable Frequency Drive (VFD) aka PowerFlex 40 is mounted on the LCW side of the main control panel. Turn the small speed control knob fully counterclockwise. Press the green "|" button. Slowly rotate the speed knob clockwise until the speed reads 40.0 Hz.

7. Because of the open bypass valve V37, the supply pressure (gauge P7 on the EH end of the BCS proper) should be low (less than 20 psi) and the flow very high.

8. *Turn off the B-CAL front end electronics* (EH racks 1 and 2).

9. *Caution on completing the switch-over.* The following five steps should be completed as quickly as can be done without committing errors. Five minutes is the absolute maximum allowed time from the first to last step. Therefore review these steps carefully before proceeding.

10. *Inhibit interlock SIAMs* Inhibit EMC-GEN SIAM_1 channel 0 and 6.

11. *Set BCS LCW mode in EPICS* Go to the display odc_main → cen → cooling → BCS → LCW EMC/DRC and set the operation mode to "EMC."

12. *Isolate the primary system*Open valve V38, then close V25 and V29, in sequence.

13. *Connect the BCS* - Open V35 and then open V33.

14. *Close the start-up bypass* - Close V37 in small increments while monitoring the P7 pressure. It should not exceed 60 psi. If the pressure gets above 50 psi then lower frequency setting on the VFD to bring this pressure down. Repeat this cycle of closing V37 and adjusting the VFD in small steps until V37 is fully closed.

15. *Adjust the BCS pressure and flow* - Adjust the VFD to obtain 50 psi pressure. This will be about 50 Hz on the VFD.

16. *Activate the BCS flow interlock* Check the Green LED is on, meaning that the system has sufficient flow for operation. Activate flow-switch by switching to "Enable". (The switch-over allows a two-second delay from "Bypassed" to "Enable")

17. Turn off the B-CAL water heat exchanger. (Optional)

18. *Activate EMC SIAM* Uninhibit EMC-GEN SIAM_1 channel 7.

19. If there are no alarms, the B-CAL front end electronics may be turned on, if necessary.

20. Follow the EMC ADB temperatures until equilibrium is reached.

20.5.2 Transfer from BCS Operation to B-Cal Chiller

1. *Turn off the B-CAL front end electronics* (EH racks 1 and 2). This is unnecessary if the actual swap is made within a few minutes.
2. *Prepare for primary system operation* - Verify that V38 is open.
3. *Start the primary system* - Start B-Cal chiller if necessary.
4. *Remove BCS flow interlock* - Bypass system flow-switch, switch to “By-pass”.
5. *Caution on completing the switch-over.* The following four steps should be completed as quickly as can be done without committing errors. Five minutes is the absolute maximum allowed time from the first to last step. Therefore review these steps carefully before proceeding.
6. Inhibit EMC-GEN SIAM_1 channel 7.
7. *Set BCS LCW mode in EPICS* Go to the display odc_main → cen → cooling → BCS → LCW EMC/DRC and set the operation mode to “Not in use.”
8. *Isolate the BCS* - Open V37. Close V33, V35.
9. *Connect to the detector* Open V25 and V29. Close V38.
10. Uninhibit EMC-GEN SIAM_1 channels 0 and 6.
11. *Shut down the BCS LCW system.* Turn the control switch to the “Off” position. Move the disconnect lever on the motor starter to “Off”. Set the bypass switch to “off”.
12. *Secure the BCS* - Close vent valve at reservoir. Close chilled water valve V53.
13. Turn the B-CAL front end electronics back on, if necessary.

20.6 Positive Pressure LCW for the DRC

20.6.1 Transfer to BCS Operation

1. *Bring up EPICS panel* Start EPICS on either a laptop or an EH workstation. Go to the display odc_main → cen → cooling → BCS → LCW EMC/DRC.

2. *Turn on the chilled water to the heat exchanger* - Open chilled water valves V52 and V53.

3. Configure the water valve panel - Verify that V33, V34, V35 and V36 are closed, and that V37 is 1/3 open.

4. *Configure the BCS* - Verify that V44, V46, V47, and V50 are closed, and that V45, V48, V49, and V51 are open. Open the vent valve and the valve to the pressure relief valve. These last two are on top of the reservoir. Check LCW reservoir level, fill if necessary.

5. *Configure the LCW section of the main control panel* - Use the arrow keys on the controller keypad to set the temperature (SP) on the LCW controller to 15.0 C. The DRC flow-switch mode must be set to “By-passed” (Red LED “on”). All other LCW flow-switch modes must be set to “Off” (middle position). Make sure the fluid level is sufficient (Green LED “on”). Check that the main control switch (just to the right of the controller unit) is in the “Off” position.

6. *Start the BCS* - Find the motor starter box on the LCW side of the BCS. Set Hand-Off-Auto switch on the motor starter to the “Off” position, move the disconnect switch lever on the right side of the motor starter to the “On” (up) position, then turn the Hand-Off-Auto switch to the “Auto” position. Turn the main control switch (back on the LCW portion of the main control panel) to the “On” position. The Variable Frequency Drive (VFD) aka PowerFlex 40 is mounted on the LCW side of the main control panel. Turn the small speed control knob fully counterclockwise. Press the green “|” button. Slowly rotate the speed knob clockwise until the speed reads 35.0 Hz.

7. Because of the open bypass valve V37, the supply pressure (P7, which is on the EH end of the BCS proper) should be low (less than 20 psi) and the flow high. The flow is checked on the EPICS panel.

8. *Turn off the DRC FEE crates* (EPICS). This step is not mandatory for operators familiar enough with the system to do the actual switch-over within 5 minutes.

9. *Caution on completing the switch-over.* The following six steps should be completed as quickly as can be done without committing errors. Five minutes is the absolute maximum allowed time from the first to last step. Therefore review these steps carefully before proceeding.

10. Inhibit the DRC FEE SIAM channels 0 and 1. This SIAM is in EH rack 7, elevation 11, rightmost slot.

11. *Set BCS LCW mode in EPICS* Go to the display odc_main → cen → cooling → BCS → LCW EMC/DRC and set the operation mode to "DRC."

12. Turn off the DRC chiller.

13. *Isolate the primary system* - Close V28, and V32 in sequence.

14. *Connect the BCS* - Open valve V36 and then open V34.

15. *Close the start-up bypass* - Close V37. Adjust the VFD to get the desired supply pressure (P7). Anywhere between 40 and 50 psi will do. The VFD should be near 44 Hz.

16. *Activate the BCS flow interlock* - Check the Green LED is on, meaning that the system has sufficient flow for operation. Activate flow-switch by switching to "Enable". (The switch-over allows a two-second delay from "Bypassed" to Enable")

17. Uninhibit DRC-MON FEE SIAM channel 2.

18. If there are no alarms, the DRC FEE crates may be turned on.

19. Follow the crate temperatures until equilibrium is reached.

20.6.2 Transfer from BCS Operation to DIRC Chiller

1. *Turn off the DRC FEE crates* (EPICS). This step is not mandatory for operators familiar enough with the system to do the actual switch-over within 5 minutes.
2. *Set BCS LCW mode in EPICS* Go to the display odc_main → cen → cooling → BCS → LCW EMC/DRC and set the operation mode to "Not in use."
3. *Remove the BCS flow interlock* - Bypass system flow-switch
4. *Caution on completing the switch-over.* The following six steps should be completed as quickly as can be done without committing errors. Five minutes is the absolute maximum allowed time from the first to last step. Therefore review these steps carefully before proceeding.
5. Inhibit DRC-MON FEE SIAM channel 2.
6. *Isolate the BCS system* - Open V37 to open position. Close V34, V36.
7. *Prepare for primary system operation* - Open V32. Open V28.
8. *Start the primary system* - Start DRC chiller.
9. Shut down BCS LCW system. Turn the control switch to the "Off" position. Move the disconnect lever on the motor starter to "Off".
10. *Secure the BCS* - Close vent valve at reservoir.
11. Uninhibit DRC-MON FEE SIAM channels 0 and 1.
12. Turn DRC FEE crates back on, if necessary.
13. *Drain BCS, re-fill with LCW.* (See 20.8.)

20.7 Sub-atmospheric Pressure LCW for the DCH

Note: This operational mode utilizes the centrifugal pumps suction to create a sub-atmospheric DCH system pressure.

20.7.1 Transfer to BCS Operation

1. *Bring up EPICS panel* Start EPICS on either a laptop or an EH workstation. Go to the display odc_main → cen → cooling → BCS → LCW DCH.
2. *Turn on the chilled water to the heat exchanger* - Open chilled water valves V52 and V53.
3. *Configure the fluorinert valve panel* - Verify that V7 and V8 are closed;
4. *Configure the water valve panel* - Verify that V33, V34, V35 and V36 are closed, and that V37 is open; and V40 is closed.
5. *Configure the BCS* - Verify that V44, V46, V47, and V50 are closed and V45, V48, V49, and V51 are open. Open the vent valve and the valve to the pressure relief valve. These last two are on top of the LCW reservoir. Check the LCW reservoir level, fill if necessary.
6. *Configure the LCW section of the main control panel* - Use the arrow keys on the controller keypad to set the temperature (SP) on the LCW controller to 16.7 C. The LCW DCH flow-switch mode must be set to "By-passed" (Red LED "on"). All others must be "Off" (middle position). Make sure the fluid level is sufficient (Green LED "on"). Check that the main control switch (just to the right of the controller unit) is "Off".
7. *Start the BCS* - Find the motor starter box on the LCW (detector) side of the BCS. Set Hand-Off-Auto switch on the motor starter to the "Off" position, move disconnect switch lever on the right side of the motor starter to the "On" (up) position, then turn the Hand-Off-Auto switch to the "Auto" position. Turn the main control switch (back on the LCW portion of the main control panel) to the "On" position. The Variable Frequency Drive (VFD) aka "PowerFlex 40" is mounted on the LCW side of the main control panel. Turn the small speed control knob fully counterclockwise. Press the green "|" button. Slowly rotate the speed knob clockwise until the speed reads 35.0 Hz.
8. Because of the open bypass valve V37, the supply pressure (P7 on the EH end of the BCS proper) should be low (about 8 psi) and the flow high.
9. *Create negative system pressure* - Open V46. Partially close V45 and V47 so that pressure on the compound gauge P5 is 15 in. Hg (-7.5 psig).
10. *Caution on completing the switch-over.* The following four steps should be completed as quickly as can be done without committing errors. Five minutes is the absolute maximum allowed time from the first to last step. Therefore review these steps carefully before proceeding.

11. *Set BCS LCW mode in EPICS* Go to the display odc_main → cen → cooling → BCS → LCW DCH and set the operation mode to "DCH."

12. *Isolate the primary system* Open the bypass valve in the DCH heat exchanger or turn the DCH heat exchanger off. On the fluorinert valve panel, close valves V2, V4.

13. *Connect the BCS* Open V7, V8 on Fluorinert valve panel and V44 on the BCS.

14. *Close the start-up bypass* - On the BCS, close V45 in small increments while monitoring the P5 pressure for 15 in. Hg. If the pressure gets too negative, lower the VFD setting. Repeat until V45 is completely closed.

15. *Adjust the BCS system pressure and flow* - Adjust the VFD to obtain 7.5 psig (-15 in Hg gauge or 7.7 psia) pressure (on P5 or EPICS) and about 8 gpm flow (on EPICS).

16. *Activate the BCS flow interlock* - Check that the Green DCH flow LED is on, meaning that the system has sufficient flow for operation. Activate flow-switch by switching to "Enable". (The switch-over allows a two-second delay from "Bypassed" to Enable").

17. Turn on the DCH LV power (EH rack 11), if necessary.

18. Follow the DC FEA temperatures until they reach equilibrium. Adjust the BCS temperature setting if necessary.

20.7.2 Transfer from BCS Operation to DCH Heat Exchanger

1. The DCH heat exchanger may be started in bypass mode at this time. This is not required if there is confidence that it will start without problems.
2. Turn off DCH LV power (EH rack 11). This step is not mandatory if the swap can be made within a few minutes.
3. *Set BCS LCW mode in EPICS* Go to the display odc_main → cen → cooling → BCS → LCW DCH and set the operation mode to "Not in use."
4. *Remove the BCS flow interlock* - Bypass the DCH system flow-switch (on the BCS main control panel).
5. *Caution on completing the switch-over.* The following four steps should be completed as quickly as can be done without committing errors. Five minutes is the absolute maximum allowed time from the first to last step. Therefore review these steps carefully before proceeding.
6. *Isolate the BCS* - Open V45. Close V44 and V46.
7. *Prepare for primary system operation* Close V7, V8, Open V2, and V4.
8. *Start the primary system* - Start DCH chiller if off. Close the bypass valve in the DCH heat exchanger if open. Monitor flow/pressure.
9. *Turn on DCH LV power* If necessary.
10. *Shut down BCS LCW system.* Turn the control switch to the "Off" position. Move the disconnect lever on the motor starter to "Off". Close chilled water valve V52.
11. *Drain BCS, re-fill with LCW.* (See section 20.8.)

20.8 LCW System Flush

After the LCW system has been used for the DCH or the DRC, or before using for the EMC when the system has been idle for more than a week, the LCW system should be flushed.

1. The system should be off.
2. V44, V46, v47, and V50 should be closed. V45, V48, and V51 should be open.
3. V33, V34, V35, and V36 should be closed. V37 should be 1/3rd open.
4. Open the vent valve on top of the LCW reservoir.
5. Open the 3/8" drain valve on the lowest of the large pipes connecting the BCS to the water panel. This valve is just to the right of the water valve panel, about two meters above the floor. It has poly tubing connected to it. Wait for all the water to drain (about ten minutes). The water drains to the sump next to the South wall.
6. Close the drain valve. Open the LCW make-up valve on top of the reservoir and fill until the LCW level reaches the middle of the sight gauge. Close the fill valve.
7. *Turn on the chilled water to the heat exchanger* - Open chilled water valves V52 and V53.
8. *Configure the control panel* - The LCW B-CAL flow-switch mode must be set to "By-passed" (Red LED "on"). All other flow switch controls must set to off (middle position). Make sure the fluid level is sufficient (Green LED "on"). Check that the main control switch (just to the right of the controller unit) to the "Off" position.
9. *Start the BCS* - Find the motor starter box on the LCW (detector) side of the BCS.Set Hand-Off-Auto switch on the motor starter to the "Off" position, move disconnect switch lever on the right side of the motor starter to the "On" (up) position, then turn the Hand-Off-Auto switch to the "Auto" position. Turn the main control switch (back on the LCW portion of the main control panel) to the "On" position. The Variable Frequency Drive (VFD) aka "PowerFlex 40" is mounted on the LCW side of the main control panel. Turn the small speed control knob fully counterclockwise. Press the green "|" button. Slowly rotate the speed knob clockwise until the speed reads 30.0 Hz.
10. *Adjust the LCW level* Add LCW to reservoir to bring it back to the mid-level.
11. *Turn off the BCS*. On the main control panel, turn the LCW main control switch to "Off". On the pump motor start panel, set the Hand-Off-Auto switch and the big power disconnect switch to "Off". Close V53. Set all the flow switch status switches on the main control panel to "off".
12. Repeat if the original contamination level was high.

20.9 Fluorinert for B-Cal aka Barrel

20.9.1 Transfer to BCS Operation

1. *check Spare chiller* - Be sure the spare Fluorinert chiller is either off or running in bypass mode, and that V16 and V17 are closed. If the spare chiller is in use, see the instructions for transfer from spare chiller to BCS. Note that the spare chiller and the BCS Fluorinert systems may not be used simultaneously. The BCS or the Spare may be used for both the B-CAL and the F-CAL only under the supervision of EMC cooling experts. Care must be taken to avoid connecting the BCS system to any of the chillers as this will result in an expensive fluorinert spill.

2. *Bring up EPICS panel* Start EPICS on either a laptop or an EH workstation. Go to the display odc_main → cen → cooling → BCS → FLU.

3. *Turn on the chilled water to the heat exchanger* - Open chilled water valves V42 and V43.

4. *Configure the BCS* - Verify that V22 and V24 are closed. Open V23 to 1/3 open position. V41 should be open.

5. *Check the BCS reservoir level* - Check Fluorinert reservoir level, fill if necessary. Open vent valves.

6. *Configure the control panel* - Use the arrow keys on the Fluorinert controller keypad to set the temperature (SP) to 18.8 C. The Fluorinert B-CAL flow-switch must be set to "By-passed" (Red LED "on"). Make sure the reservoir level is sufficient (Green LED "on"). Set the main control switch (just to the right of the controller unit) to the "Off" position.

7. *Start the BCS* - On the Set Hand-Off-Auto switch on the Fluorinert motor starter to the "Off" position, move the power disconnect switch lever on the right side of the motor starter to the "On" (up) position, then turn the Hand-Off-Auto switch to the "Auto" position. Back on the main control panel, turn the main control switch to the "On" position. The Variable Frequency Drive (VFD) aka PowerFlex 40 is mounted on the Fluorinert (East) side of the main control panel. Turn the small speed control knob fully counterclockwise. Press the green "|" button. Slowly rotate the speed knob clockwise until the speed reads 40.0 Hz.

8. Turn off the B-CAL front end electronics (EH racks 1 and 2). This step may not be necessary if the switch over procedure is well understood since the actual switch over takes less than a minute.

9. Inhibit EMC-GEN SIAM_1 channels 1, 2, 3, and 4.

10. **V18 and V20 should already be closed.**

11. *Bypass and isolate the B-CAL Fluorinert chiller.* - Open V9, then Close V13 and V15 in sequence.

12. The EMC B-CAL Fluorinert chiller may now be turned off if desired.

13. *Connect the BCS* - Open V21 and V19. Open V22 and V24.

14. *Close the start-up bypass* - Close V23. Adjust the VFD so that supply pressure (P3 on the EH end of the BCS proper) reads 44 psig. This will be about 46 Hz. The flow (read from EPICS) should be about 16 gpm.

15. *Activate the BCS flow interlock* - Check that the Green B-CAL flow LED is on, meaning that the system has sufficient flow for operation. Activate the flow-switch by switching to "Enable". (The switch-over allows a two-second delay from "Bypassed" to Enable").

16. Uninhibit (*after successfully resetting*) EMC-GEN SIAM_3 channels 4 and 5, SIAM_2 channels 0, 1, and 2, and EMC-GEN SIAM_1 channel 5.

17. *Set BCS FLU mode in EPICS* Go to the display odc_main → cen → cooling → BCS → Fluorinert and set the B-CAL Mode to "In use."

18. If there are no alarms, the B-CAL front end electronics may be turned on.

19. Follow the EMC crystal temperatures until equilibrium is reached.

20.9.2 Transfer from BCS Operation to B-Cal Fluorinert Chiller

1. *Turn off the B-CAL front end electronics* (EH racks 1 and 2). This is not essential if you are confident that you can make the switch-over in less than a minute.

2. Inhibit EMC-GEN SIAM_3 channels 4 and 5, SIAM_2 channels 0, 1, and 2,and EMC-GEN SIAM_1 channel 5.

3. *Set BCS FLU mode in EPICS* Go to the display odc_main → cen → cooling → BCS → Fluorinert and set the B-CAL Mode to "Not in use".

4. *Remove the BCS flow interlock* - Bypass system flow-switch, switch to "By-pass".

5. *Start the primary system if it is not already running in bypass* - Open V9. Start B-Cal Fluorinert chiller.

6. *Isolate the BCS* - Open V23 1/3, then close V22, V24, V19, and V21.

7. Start flow through the detector - Open V15 and V13. Close V9.

8. *Check* - Check the barrel chiller for proper flow and pressure.

9. *Secure the BCS* - Turn the Fluorinert main control switch on the main control panel to 'off". On the pump motor starter, turn the Hand-Off-Auto switch and the big power disconnect switch to "off". Close V43. Set the bypass switch to "off".

10. Uninhibit EMC-GEN SIAM_1 channels 1, 2, 3, and 4.

11. Turn the B-CAL front end electronics back on.

20.10 Fluorinert for F-CAL aka Endcap aka FWD EC

20.10.1 Transfer to BCS Operation (from FWD EC chiller)

1. *check Spare chiller* - Be sure the spare Fluorinert chiller is either off or running in bypass mode, i.e., that V16 and V17 are closed. If the spare chiller is in use, see the instructions for transfer from the spare to the BCS. Note that the spare chiller and the BCS Fluorinert systems may not be used simultaneously. The BCS or the Spare may be used for both the B-CAL and the F-CAL only under the supervision of EMC cooling experts. Care must be taken to avoid connecting the BCS system to any of the chillers as this will result in an expensive fluorinert spill.

2. *Bring up EPICS panel* Start EPICS on either a laptop or an EH workstation. Go to the display odc_main → cen → cooling → BCS → FLU.

3. *Turn on the chilled water to the heat exchanger* - Open chilled water valves V42 and V43.

4. *Configure the BCS* - Verify that V22 and V24 are closed. Open V23 to 1/3 open position. V41 should be open.

5. *Check the BCS reservoir level* - Check Fluorinert reservoir level, fill if necessary. Open vent valves.

6. *Configure the control panel* - Set the temperature (SP) on controller to 15.6 C using the Fluorinert controller keypad. The Fluorinert F-CAL flow-switch must be set to “By-passed” (Red LED “on”). Make sure the reservoir level is sufficient (Green LED “on”). Check that the control switch (just to the right of the controller unit) to the “Off” position.

7. *Start the BCS* - On the Set Hand-Off-Auto switch on the Fluorinert motor starter to the “Off” position, move disconnect switch lever on the right side of the motor starter to the “On” (up) position, then turn the Hand-Off-Auto switch to the “Auto” position. Back on the main control panel, turn the main control switch to the “On” position. The Variable Frequency Drive (VFD) aka PowerFlex 40 is mounted on the Fluorinert (East) side of the main control panel. Turn the small speed control knob fully counterclockwise. Press the green “|” button. Slowly rotate the speed knob clockwise until the speed reads 40.0 Hz.

8. *Turn off the EMC F-CAL front end electronics* (EH rack 3). This is not strictly necessary. If the transfer procedure is clearly understood ahead of time, the transfer may be done hot, since it only takes a minute.

9. Inhibit EMC-GEN SIAM_0 channels 0, 1, 2, and 3.

10. **V19 and V21 should already be closed.**

11. *Bypass and isolate the F-CAL Fluorinert chiller* - Open V10. Close V12, V14 in sequence.

12. *Connect the BCS* - Open V20 and V18. Open V22 and V24. Close V23.
13. *Adjust* - Adjust the VFD so that P3 reads 52 psig. This will be about 46 Hz.
14. The F-CAL Fluorinert chiller may now be turned off if desired.
15. *Activate the BCS flow interlock* - Check that the Green LED is on, meaning that the system has sufficient flow for operation. Activate flow-switch by switching to "Enable". (The switch-over allows a two-second delay from "Bypassed" to Enable"), switch to "Enable". (This switch currently is not working and must remain bypassed.)
16. Uninhibit (*after* successfully resetting) EMC-GEN SIAM_3 channels 4 and 5, SIAM_2 channels 0, 1, and 2, and EMC-GEN SIAM_0 channel 4.
17. *Set BCS FLU mode in EPICS* Go to the display odc_main → cen → cooling → BCS → Fluorinert and set the F-CAL Mode to "In use."
18. *Turn on FEE* If there are no alarms, the F-CAL front-end electronics may be turned on.
19. *Monitor temperatures* Follow the EMC F-CAL crystal temperatures until equilibrium is reached. Adjust the controller setting as needed.

20.10.2 Transfer from BCS Operation to F-CAL Fluorinert Chiller

1. *Turn off the EMC F-CAL front end electronics* (EH rack 3). This is not essential if you are confident you make the switch-back in less than a minute.
2. Inhibit EMC-GEN SIAM_3 channels 4 and 5, SIAM_2 channels 0, 1, and 2, and EMC-GEN SIAM_0 channel
3. *Set BCS FLU mode in EPICS* Go to the display odc_main → cen → cooling → BCS → Fluorinert and set the F-CAL Mode to "Not in use."
4. *Remove the BCS flow interlock* - Bypass system flow-switch, switch to "By-pass".
5. *Start the primary system if it is not already running in bypass* - Open V10. Start F-CAL Fluorinert chiller.
6. *Isolate the BCS* - Open V23 to 1/3 open. Close V22, V24, V18, and V20.
7. Start flow through the detector - Open V12 and V14. Close V10.
8. *Secure the BCS* - Shut down BCS Fluorinert system by turning the main control switch (on the main control panel) off. On the pump motor starter, set the Hand-Off-Auto switch and the big power disconnect switch to "off". Close V43. Set the bypass switch of "off".
9. Uninhibit EMC-GEN SIAM_1 channels 0, 1, 2, and 3.
10. Turn the B-CAL front end electronics back on.

20.11 Fluorinert for Spare for B-CAL (F-CAL)

20.11.1 Transfer to BCS Operation (from Spare chiller)

1. *check the Spare chiller* - Be sure that the spare Fluorinert chiller is in use. V16 and V17 should be open and V11 (mostly) closed. V19 and V21 (B-CAL) or V18 and V20 (F-CAL) should be open. V13 and V15 (B-CAL) or V12 and V14 (F-CAL) should be closed. If this is not the case, then the spare chiller is not in use and you should be using a different procedure. Note that the spare chiller and the BCS may not be used simultaneously. Also, the spare chiller or BCS Fluorinert may be used with the B-CAL and the F-CAL simultaneously only with the assistance of super experts. This is not routine. Care must be taken to avoid connecting the BCS system to any of the chillers as this will result in an expensive fluorinert spill.

2. *Bring up EPICS panel* Start EPICS on either a laptop or an EH workstation. Go to the display odc_main → cen → cooling → BCS → FLU.

3. *Turn on the chilled water to the heat exchanger* - Open chilled water valves V42 and V43.

4. *Configure the BCS* - Verify that V22 and V24 are closed. Open V23 to 1/3 open position. V41 should be open.

5. *Check the BCS reservoir level* - Check Fluorinert reservoir level, fill if necessary. Be sure the fill cap is securely in place when done. Check that both vent valves are open.

6. *Configure the control panel* - On the BCS main control panel, set the temperature (SP) on the controller to 18.8 C using the Fluorinert controller keypad. Also on the main control panel, the Fluorinert B-CAL (F-CAL) flow-switch must be set to "By-passed" (Red LED "on"). Make sure the reservoir level is sufficient (Green LED "on"). Check that the control switch (just to the right of the controller unit) is in the "Off" position.

7. *Start the BCS* - On the Set "Hand-Off-Auto" switch on the Fluorinert motor starter to the "Off" position, move disconnect switch lever on the right side of the motor starter to the "On" (up) position, then turn the Hand-Off-Auto switch to the "Auto" position. Back on the main control panel, turn the main control switch to the "On" position. The Variable Frequency Drive (VFD) aka PowerFlex 40 is mounted on the Fluorinert (East) side of the main control panel. Turn the small speed control knob fully counterclockwise. Press the green "|" button. Slowly rotate the speed knob clockwise until the speed reads 30.0 Hz.

8. *Turn off the B-CAL (F-CAL) front end electronics* (EH rack 3). This is not strictly necessary. If the transfer procedure is clearly understood ahead of time, the transfer may be done hot, since it only takes a minute.

9. Inhibit EMC-GEN SIAM_3 channels 0, 1, 2, and 3.

10. *Bypass the Spare Fluorinert chiller* - Open V11.
11. *Isolate the spare chiller* - Close V16, V17 in sequence.
12. *Connect the BCS* - Open V22 and V24.
13. *Close the start-up bypass* - Close V23. Adjust the VFD so that the supply pressure (P3 on the EH end of the BCS proper) reads 40 psig (55 psig). This will be about 50 Hz.
14. *Activate the BCS flow interlock* - Check that the Green B-CAL (F-CAL) Fluorinert flow LED is on, meaning that the system has sufficient flow for operation. Activate flow-switch by switching to "Enable". (The switch-over allows a two-second delay from "Bypassed" to "Enable"). (The F-CAL switch currently is not working and must remain bypassed.)
15. Uninhibit (*after* successfully resetting) EMC-GEN SIAM_3 channels 4 and 5, SIAM_2 channels 0, 1, and 2, and EMC-GEN SIAM_0 channel 4.
16. *Set BCS FLU mode in EPICS* Go to the display odc_main → cen → cooling → BCS → Fluorinert and set the B-CAL (F-CAL) Mode to "In use."
17. *Turn on FEE* If there are no alarms, the F-CAL front end electronics may be turned on (if it was turned off in the first place).
18. The Spare Fluorinert chiller may now be turned off if desired.
19. *Monitor temperatures* Follow the EMC F-CAL crystal temperatures until equilibrium is reached. Adjust the controller setting as needed.

20.11.2 Transfer from BCS Operation to Spare Fluorinert Chiller

1. *Start the spare chiller if it is not already running in bypass* - Open V10. V16 and V17 should already be closed. Start Spare Fluorinert chiller.
2. *Turn off the EMC F-CAL front end electronics* (EH rack 3, this is not necessary if you can do the switch over in a few minutes.).
3. Inhibit EMC-GEN SIAM_3 channels 4 and 5, and SIAM_2 channels 0, 1, and 2.
4. *Set BCS FLU mode in EPICS* Go to the display odc_main → cen → cooling → BCS → Fluorinert and set the B-CAL (F-CAL) Mode to "Not in use."
5. *Remove the BCS flow interlock* - On the BCS main control panel, set the B-CAL (F-CAL) flow-switch mode to "By-pass".
6. *Isolate the BCS* - Set the VFD to 30 Hz. Open V23 to 1/3 open. Close V22 and V24.
7. Start flow through the detector - Open V17 and V16. Close V11 slowly to about 1/4 open.
8. *Adjust* - Adjust V11 to achieve design pressure, about 55 psig.
9. Uninhibit EMC-GEN SIAM_3 channels 0, 1, 2, and 3.
10. *Secure the BCS* - Shut down BCS Fluorinert system by turning the main control switch (on the main control panel) to "off". On the pump motor starter, set the "Hand-Off-Auto" switch and the big power disconnect switch to "off". Close V43.
11. If needed, turn the B-CAL front end electronics back on.

20.12 Adding the B-CAL (F-CAL) to Fluorinert for the F-CAL (B-CAL)

20.12.1 Transfer to BCS Operation (from B-CAL (F-CAL) chiller)

1. *check the Spare chiller* - Be sure that the BCS Fluorinert system is in use and the spare is not. V16 and V17 should be closed. V22 and V24 should be open. V23 should be closed. V19 and V21 (B-CAL in use) or V18 and V20 (F-CAL in use) should be open. V13 and V15 (B-CAL in use) or V12 and V14 (F-CAL in use) should be closed. If this is not the case, then the BCS is not in use and you should be using a different procedure. Note that the spare chiller and the BCS may not be used simultaneously. Also, the spare chiller or BCS Fluorinert may be used with the B-CAL and the F-CAL simultaneously only with the assistance of super experts. This procedure is not routine. Care must be taken to avoid connecting the BCS system to any of the chillers as this will result in an expensive fluorinert spill.

2. *Bring up EPICS panel* Start EPICS on either a laptop or an EH workstation. Go to the display odc_main → cen → cooling → BCS → FLU.

3. *Turn off the B-CAL (F-CAL) front end electronics* (EH racks 1, 2, and/or 3). This is not strictly necessary. If the transfer procedure is clearly understood ahead of time, the transfer may be done hot, since it only takes a minute.

4. If the BCS is currently in use for the F-CAL, lower the VFD setting so that P3 reads 44 psig or a bit less.

5. Inhibit EMC-GEN SIAM_1 (SIAM_0) channels 0, 1, 2, and 3.

6. *Bypass the B-CAL (F-CAL) Fluorinert chiller* - Open V9 (V10).

7. *Isolate the B-CAL (F-CAL) chiller* - Close V13, V15 (V12, V14) in sequence.

8. *Connect the B-CAL (F-CAL) to the BCS* - Open V19 and V21 (V18 and V20).

9. *Balance the two systems* - Close V5 until P20 pressure drops about 5 psi. P20 should read a few psi than P3.

10. *Adjust the settings* - Adjust the VFD so that P3 reads 40 psig. This will be about 43 Hz. P20 should read 40 psig. If not, adjust V5 and the VFD to get this balance.

11. *Activate the BCS flow interlock* - Check that the Green B-CAL (F-CAL) Fluorinert flow LED is on, meaning that the system has sufficient flow for operation. Activate B-CAL flow-switch by switching to "Enable" and setting the F-CAL switch to "Off". You have less than 2 seconds to complete the switch once you start.

12. *Set BCS FLU mode in EPICS* Go to the display odc_main → cen → cooling → BCS → Fluorinert and set the B-CAL (F-CAL) Mode to "In use."

13. *Turn on FEE* If there are no alarms, the F-CAL front end electronics may be turned on (if it was turned off in the first place).

14. *(* Adjust the temperature) Set the controller SP to 18.5 C.

15. *Monitor temperatures* Follow the EMC F-CAL crystal temperatures until equilibrium is reached. Adjust the controller setting as needed to achieve crystal temperatures near 20 C. If the the F-CAL and B-CAL temperatures are too far apart, adjust V5 to balance the cooling (taking care not to overpressure the B-CAL). Clockwise will increase the B-CAL temperature with respect to that of the F-CAL and vice versa.

16. The B-CAL (F-CAL) Fluorinert chiller may now be turned off if desired.

20.12.2 Transfer from BCS Operation to B-CAL (F-CAL) Fluorinert Chiller while BCS continues to be used for the F-CAL (B-CAL)

1. *Start the B-CAL (F-CAL) chiller if it is not already running in bypass* - Open V9 (V10). **V13 and V15 (V12 and V14) should already be closed.** Start the B-CAL (F-CAL) Fluorinert chiller.

2. *Turn off the B-CAL (F-CAL) front end electronics* (EH rack 1,2, and/or 3), this is not necessary if you can do the switch over in a few minutes.).

3. Inhibit EMC-GEN SIAM_3 channels 4 and 5, and SIAM_2 channels 0, 1, and 2.

4. *Set BCS FLU mode in EPICS* Go to the display odc_main → cen → cooling → BCS → Fluorinert and set the B-CAL (F-CAL) Mode to "Not in use."

5. *Remove the BCS flow interlock* - On the BCS main control panel, if the B-CAL (F-CAL) flow-switch mode is "Enable"d , set it to "By-pass".

6. (Lower the total BCS flow) - Reduce the VFD setting by 15 Hz.

7. Disconnect from BCS - Close V19 and V21 (V18 and V20).

8. Start chiller flow through the detector - Open V13 and V15 (V12 and V14). Close V9 (V10).

9. *Adjust* - Adjust the VFD to achieve design pressure at P3, for BCS F-CAL (B-CAL) operation. If B-CAL is still on the BCS, open valve V5 fully. Readjust the VFD.

10. *Adjust* - Check the B-CAL (F-CAL) chiller for proper operation.

11. Uninhibit EMC-GEN SIAM_1 (SIAM_0) channels 0, 1, 2, and 3. Inhibit EMC-GEN SIAM_1 (SIAM_0) channel 4.

12. If needed, turn the B-CAL (F-CAL) front end electronics back on.

20.13 Appendix

- Operational notes for the BCS control panel (R. Rodriguez, 17 Mar 03)
- The panel has 7 sets of LED's and switches. Reading from top to bottom:
- LCW tank level okay: This is a green LED only and cannot be bypassed. The pump will not start without this LED being on.
- LCW B-CAL Flow: Red, 3 way switch and green LED. Red LED indicates that the flow switch has been bypassed and a B-CAL flow okay is being sent to the SuperRelay. Green LED indicates that the actual flow switch is closed indicating good flow. Both the red and the green LED's can be on at the same time.
  - Switch operation - bypassed sends a flow okay indication to the relay logic. Off sends a no flow signal to the logic and enabled with follow the status of the Green LED and send the appropriate signal to the logic.
- LCW DRC Flow: Red, 3 way switch and green LED. Red LED indicates that the flow switch has been bypassed and a DRC flow okay is being sent to the SuperRelay. Green LED indicates that the actual flow switch is closed indicating good flow. Both the red and the green LED's can be on at the same time.
  - Switch operation - bypassed sends a flow okay indication to the relay logic. Off sends a no flow signal to the logic and enabled with follow the status of the Green LED and send the appropriate signal to the logic.
- LCW DCH Flow: Red, 3 way switch and green LED. Red LED indicates that the flow switch has been bypassed and a DCH flow okay is being sent to the SuperRelay. Green LED indicates that the actual flow switch is closed indicating good flow. Both the red and the green LED's can be on at the same time.
  - Switch operation - bypassed sends a flow okay indication to the relay logic. Off sends a no flow signal to the logic and enabled with follow the status of the Green LED and send the appropriate signal to the logic.
- Fluorinert tank level okay: This is a green LED only and cannot be bypassed. The pump will not start without this LED being on.
- Fluorinert B-CAL Flow: Red, 3 way switch and green LED. Red LED indicates that the flow switch has been bypassed and a B-CAL flow okay is being sent to the SuperRelay. Green LED indicates that the actual flow switch is closed indicating good flow. Both the red and the green LED's can be on at the same time.
  - Switch operation - bypassed sends a flow okay indication to the relay logic. Off sends a no flow signal to the logic and enabled with follow the status of the Green LED and send the appropriate signal to the logic.

- Fluorinert F-CAL Flow.: Red, 3 way switch and green LED. Red LED indicates that the flow switch has been bypassed and a F-CAL flow okay is being sent to the SuperRelay. Green LED indicates that the actual flow switch is closed indicating good flow. Both the red and the green LED's can be on at the same time.
  - Switch operation - bypassed sends a flow okay indication to the relay logic. Off sends a no flow signal to the logic and enabled with follow the status of the Green LED and send the appropriate signal to the logic.
- Operation........
  - The signal from only one flow switch may be either enabled or bypassed at any time. If there are more than one, the pump may start but will shut down after 5 seconds.
  - The On/Off switch will start the pump or at least send the signal to the pump starter and if that box has the switch in auto and the main switch on then the pump will start.

Part IV

WHAT TO DO WHEN ...

1. You get a message
2. You get an alarm
3. Something fails

Chapter 21

General BaBar Alarms

21.1 Introduction

BaBar alarms are announced by a doorbell (Big Ben) or beeping from the console machine running the EPICS Alarm Handler.

1. The Alarm Handler beeping advises you of a malfunction or failure of some equipment. All problems related to the Magnet system will be taken care of by the cryo crew, all others are the responsibility of the BaBar shift people.

2. The doorbell, which is driven by the control room annunciator panel (sometimes incorrectly called a "beta alarm" for historical reasons) (console top left), indicates a failure that could lead to a hazardous condition or more serious equipment failure if no action is taken, or that some action has been taken automatically which will disable part of the experiment.

It is the responsibility of the BaBar shift people to immediately respond to any of these alarms, i.e. interrupt your present activity, unless you have a serious emergency to deal with, and return to the control room.

All alarms are handled by the EPICS system, specifically by the Alarm Handler (see section 7.2). The more serious alarms are also reported on the Alarm Annunciator Panels. In the following the various Annunciator Alarm conditions are described and instructions on how to respond are given. See Chapter 22 for information on EPICS only alarms. These are guide lines, do not follow them blindly, THINK!

1. Silence the alarm by pressing the little Ack button on an Alarm Annunciator Panel. This will also cause the panel to stop flashing. The causative alarm(s) will remain red. Panels are located in the top left of the console, and at the top of rack 6 in the Electronics House. The panel in the EH is connected to the audible alarm. The panels talk to each other and alarms may be acknowledged in either location. Whoever acknowledges the alarm is responsible for seeing that the problem is addressed. This will indicate to other BaBar people in the PEP IR2 Hall that somebody is aware of, and taking care of, the problem.

2. Look at the alarm panel and identify the channel that triggered the alarm by a red flashing light.

3. Flashing green lights indicate a cleared alarm. Pressing the Ack button will stop the flashing.

4. Many of the alarms are actually summaries of several different problems. Use the EPICS alarm handler display to determine the which condition triggered the alarm. Alternatively, the "alarm" button on the odc-main EPICS display brings up an image of the alarm annunciator panel. Clicking on the red collared button will bring up the relevant display. If EPICS is not running, look at the SIAM which drives the alarm. The alarm condition locator (appendix B) tells where to find it.

5. Appendix B is a table which briefly explains the function of each alarm and gives the location of the devices which generate the alarms. More detailed descriptions these alarm conditions are given below.

6. Follow these instructions as best as you can. Diagnose and fix the problem, or call an expert to help you.

7. When you are done, reset the SIAM which drives the alarm, the red light should turn to green. Now all lights on the panels should be green and not flashing.

21.2 AC power organization

To understand many of the alarms, it is helpful to understand the EH power distribution and protection system. The EH racks are powered in three sets or "zones" (sometimes called "sectors", and not to be confused with "zones" used to describe regions covered by different VESDA heads):

1. Racks 1 through 12 are in zone 1.

2. Racks 13 through 28 are in zone 2.

3. Racks 29 through 40 (on top of the EH) are in zone 3.

For the EH VESDA system, under the floor is zone 4. The breaker panels for the three zones are (North is toward the Control Room):

1. Zone 1: two standard panels, inside EH, SW corner, PB620B-04 and PB620B-04A, and one UPS panel, also in the SW corner.

2. Zone 2: two panels, inside EH, NE corner, PB620B-02 and PB620B-03, and one UPS panel in the SE corner.

3. Zone 3: two panels, top of EH, one on each end of the racks, PB620B-05, PB620B-06, and one UPS panel near the floor opposite rack 40.

A serious zone 4 problem will affect all panels.

There are two breaker panels on top of the detector. PB620D-01 and PB620D-02.

Here is a description of how to reset power after it has been tripped. Specific information on conditions which cause trips may be found in later sections. The power is removed from the racks by activating the shunt trips which are connected to the main breakers in the panels. For EH VESDA alarms, the UPS panels trip as well, with the exception of the duplex in rack 6 and the outlets used for temperature controllers. Note that UPS outlets are so labelled. In the Electronics house, yellow labels indicate outlets that will be turned off in the event of a VESDA smoke alarm in the associated set of racks. Red labels indicate outlets that will remain on. Beige outlets are always UPS outlets. Standard outlets are dark brown. Some UPS outlets are dark brown as well. UPS outlets should be used only for special equipment.

To reset:

1. Verify that the trip was not due to a VESDA alarm. If there is an "action" level or higher EH VESDA alarm, the panels for that zone will be tripped. If the panels are tripped, power will be removed from some monitoring crates resulting in CEN:EH alarms. If there was no VESDA alarm, or after it has cleared, then

2. If there were EH VESDA alarms, the UPS will have been interrupted. The UPS power must be restored by pressing the reset buttons inside the box labeled "UPS bypass", which is on the outside of the EH on the south side, at chest height. After UPS power is on, turn on the CEN-MON, CEN-ILK, CEN-BIP, and DRC-GAS crates.

3. Check the SIAMs in CEN-ILK in EH rack 9. Correct any problems indicated SIAMs 0-7 and reset the SIAMs.

4. If some problems are understood, but uncorrectable until power is restored, then bypass the SIAM driven shunt trip for the relevant zone using the switches in the top back of EH rack 6.

5. *Wear safety glasses.*

6. Reset any tripped panel by turning the main breaker at the top of the panel off, then on. If the breaker won't latch in the off position, move it to the on position and then back to the off position. For now this would be the two standard panels for each affected zone. If the alarm was due to an "action" or higher level alarm on the detector or IR-2 VESDA systems, then the panels on top of the detector will need to be reset. This requires an access.

7. Clear any remaining faults indicated on the SIAMs in the CEN:ILK crate (top of rack 9). If the power has been off for an extended period and the ambient temperature is low, there may be (an) under temperature alarm(s). These will clear themselves in a few minutes as the equipment warms the racks.

8. *UNDO* the SIAM shunt trip bypass(es) (in the top back of rack 6).

9. If there were VESDA alarms and the power was removed from some or all for the EH and or the detector see section 26.4.5.

21.3 VESDA Alarms

A Very Early Smoke Detection Apparatus has detected smoke. We have four such devices. One samples air from the Electronics House racks, one from inside the detector, one from the IR2 Hall ceiling and adjacent PEP II tunnels, and one from the LST racks. There is a fifth device, to which we are not connected, which samples the air from farther into the PEP II tunnels.

21.3.1 The EH VESDA system

This alarm is driven by the bridged outputs of CEN:ILK SIAMs 0 and 1, which report problems from the EH VESDA system. The detector head (#1) for this system is located on the outside of the EH at the south east corner. It pulls air from each rack pair via four pipes to a location on the outside of the EH (floor level, SE corner) and analyzes it for smoke. The four pipes cover different "zones" in the EH. They are:

Zone 1: EH racks 1 to 12

Zone 2: EH racks 13 to 28

Zone 3: EH racks 29 to 40

Zone 4: EH under the floors.

There are four alarm levels.

1. "Alert" indicates a very low smoke level. This is your chance to find a problem before anything drastic happens. Use the various rack temperature sensors to locate the problem. If this doesn't work, try using your nose. Turn off the offending equipment and contact its owner.

2. "Action" indicates an incipient fire. Power is automatically removed from EH racks in the associated zone via direct connection from the VESDA system, i.e., not via a SIAM. Try to find the source of the smoke before it dissipates.

3. "Fire 1" indicates that the smoke level is nearing visibility. The evacuation klaxon sounds and the fire department is called. You must leave the IR hall until given permission to reenter by the Fire Dept.

4. "Fire 2" indicates a flaming fire. In addition to all of the above, the FM200 (heptafluoropropane, aka HFC-27ea) fire suppressant system is activated and the EH racks are flooded with fire suppressant. There are two sets of FM200 systems, one covers zones 1 and 2, while the other covers 3 and 4. All the racks covered by a system are flooded when that system is activated. If you are completely confident that it is a false alarm, you may override the suppressant system by holding down one of the abort buttons located near both EH doors and on the railing near the counting house connector on top of the EH. In practice, this may be difficult to do, since you have already left the hall! The button must be held until the alarm is cleared by the fire department. While FM200 is non-toxic, you should still evacuate the EH if the system is activated.

If there is fire in a rack, the suppressant can be manually discharged by pulling the fire alarms which are next to the abort buttons.

The output to BaBar from the VESDA unit itself is non-latching and will clear as soon as the smoke clears. The fire 1 and fire 2 outputs to the klaxon and the fire department must be cleared by the fire department or the fire technicians. There are a latches in the path from the VESDA unit to the UPS contactors. These latches may be cleared by pressing the reset buttons inside the box labelled “UPS bypass”, which is located of the outside of the south side of the EH at chest height.

The EH VESDA system also has a minor “Trouble”, serious “Trouble” and “Scanning”states, which are reported on the EH VESDA control (outside of EH at the SE corner) and at the fire technician’s remote monitoring site. The most common cause of the minor Trouble state is low flow in the sampling pipes because of open rack doors. The Scanning state indicates that the VESDA system has sensed smoke on the union of its four pipes and is scanning to find out which pipe. It also scans periodically to check the system.

For recovery after the alarm has been cleared and UPS power restored, see sections 21.2 and 26.4.5. The short version: turn on the CEN-ILK and CEN-MON crates in rack 9, reset the SIAMs in these crates, then cycle the main breakers on each of the two panels serving each of the affected zones. *Be sure to wear the Personnel Protection Equipment indicated on the panel.*. If the breaker won’t latch in the off position. Move it to the on position then back to the off position. Call the system experts for all affected systems.

21.3.2 The Detector, LST, and IR-2 Hall VESDA systems

The detector VESDA alarm is driven by the bridged outputs of CEN:ILK SIAMs 12 and 13. The LST VESDA alarm is driven by the bridged outputs of CEN:MON SIAMS 5 and 6. The IR-2 VESDA alarm is driven by the bridged outputs of CEN:ILK SIAMs 14 and 15. Action, Fire1, and Fire2 alarms from either of these systems will also trip a channel in the SIAM 2, which in turn will trip the power in EH zones 1 and 3. Because the annunciator signal and the power trip signals come from different relays, they may be in different states if the VESDA system malfunctions.

The Detector VESDA system head (#20) is located on the outside of the EH at the south west corner. It pulls air from various points around the detector via four pipes and analyzes it for smoke. The area covered by a pipe is called a “zone”. The four zones of the detector system are:

Zone 1: DCH electronics at the backward (north) end

Zone 2: the backward (north) end

Zone 3: the top, including detector racks 1 to 24

Zone 4: the forward (south) end.

The LST VESDA head is also located on the outside of the EH at the south west corner. It pulls air from the various LST front end electronics racks. The four zones are:

Zone 1: Unused

Zone 2: East mid-mezzanine platform.

Zone 3: Forward top and West racks.

Zone 4: Backward top and West racks.

The IR-2 Hall VESDA system head (#3) is located on a pillar at the near the south wall of the assembly hall next to the stairs. There is another head (#2) at this location which samples air from farther up the tunnels (PEP regions 2B3, 2B2, 2A2, and 2A3). The IR2 Hall VESDA samples smoke from around the IP area via four pipes and analyzes it for smoke. The area covered by a pipe is called a “zone”. The four zones of the hall system are:

Zone 1: tunnel south (PEP region 2B1)

Zone 2: tunnel north (PEP region 2A1)

Zone 3: power supply building 624 (south of the assembly hall)

Zone 4: IP area ceiling.

There are four alarm levels.

1. “Alert” indicates a very low smoke level. This is your chance to find a problem before anything drastic happens. Try to locate the source of the problem (this will require an access). Turn off the offending equipment and contact its owner.

2. “Action” indicates an incipient fire. Power is automatically removed from the detector electronics via direct connection from the VESDA system, i.e., not via a SIAM, and from EH zones 1 and 3 via SIAM 2 in the CEN:ILK crate . Try to find the source of the smoke before it dissipates.

3. “Fire 1” indicates that the smoke level is nearing visibility. The evacuation klaxon sounds and the fire department is called. You must leave the IR hall until given permission to reenter by the Fire Dept.

4. “Fire 2” indicates a flaming fire. It requires no additional action.

The alert and action levels are non-latching and will clear by themselves. The fire 1 and fire 2 level alarms must be cleared by the fire department.

The VESDA system also has a minor “Trouble”, serious “Trouble” and “Scanning”states, which are reported on the VESDA control (the detector control is on the outside of the EH at the SW corner, the IR2 VESDA is on the pillar next to the south wall of the Hall) and at the fire technician’s remote monitoring site. The most common cause of the minor Trouble state is low flow in the sampling pipes. Contact the fire technician. The Scanning state indicates that the VESDA system has sensed smoke on the union of its four pipes and is scanning to find out which pipe. It also scans periodically to check the system.

If the alarm was an Action or Fire level, the power will have to be restored after the alarm has been cleared. The detector power may be restored by cycling the main breakers on the two panels on top of the detector. *Be sure to wear the Personnel Protection Equipment indicated on the panel.*. If the breaker won't latch in the off position, move it to the on position then back to the off position. A controlled access will be required if the IP area is locked up. For the EH power see sections 21.2 and 26.4.5. The short version: turn on the CEN-ILK and CEN-MON crates in rack 9, reset the SIAMs in these crates, then cycle the main breakers on the four panels serving zones 1 and 3. *Be sure to wear the Personnel Protection Equipment indicated on the panel.*. If the breaker won't latch in the off position, move it to the on position then back to the off position. Call the experts for all systems.

21.4 Central System Alarms

21.4.1 Electronics House

There is a problem with Electronics House infrastructure. Currently this means that there is a problem with the system which cools the air inside the racks, there us an unusual heat source in the racks, there is water under the racks, or a safety system is inactivated.

This alarm is driven by CEN:ILK SIAM 8 which is in slot 12 of the central monitoring VME crate, which is in the upper half of rack 9 in the EH. The inputs of this SIAM are the outputs of the other SIAMs in this crate, and the shunt trip over-ride, bypass, and disable indicators. See the CEN→ MON Crate EPICS display.

- SIAMs 2, 3, and 4 are driven by "Klixons" (temperature operated switches), one in each rack pair.
- SIAMs 5, 6, and 7 are driven by temperature controller out of range indicators (one for each rack pair).
- SIAMs 9, 10, and 11 are also driven by the temperature controllers, but are activated at a warning level.
- SIAM 11, channel 6, is the "rubber duck" (InpecTek water sensor) alarm for water under the EH floors.

The Klixons

Klixons are switches which open at high temperatures. There is one sensing the air temperature in each rack pair. Their activation temperature is 54°C. An activated Klixon will cause the power to be removed from all the racks in its zone. Locate the affected racks and turn off the heat source. Call its owner.

The Under/Over temperature and Early Warning indicators

The temperature in each rack pair is controlled by regulating the cooling water temperature with a three-way mixing valve. The valve controller indicates when the temperature is out of an acceptable range. There are two alarm levels for each rack pair. The first activates the CEN EH alarm via SIAMs 9-11. The second activates the shunt trip for the affected zone via SIAMs 5-7. Temperature problems can be due to a number of causes. The following guidelines may help locate the problem:

- A single rack pair is giving an early warning.
  - Check to see that the rack doors are closed. If so, follow the instructions immediately below for a rack pair out of tolerance.
- One rack pair is out of tolerance: Check the EPICS cooling display (see section 22.2.4).
  1. If the rack is cold there is a problem with the controller. You may inhibit the SIAM channel, reset the breaker, and resume running, but notify an central systems EH expert (see 12.11). See Power Outages (section 26) for instructions on resetting breakers.
  2. If the rack is hot, there is either a controller problem or an unusual source of heat. In either case the problem must be resolved before resuming running. Check the equipment in the affected racks for signs of failure. Check the histories using the ambient database browser (right click on "Browser" in the odc_main EPICS display and select "CEN") for unusual voltages or current draws in the implicated equipment and for excursions in the rack temperature or the valve controller voltage. Sometimes, some valve controllers go on an excursion resulting in temporarily high temperatures.
  3. The most common cause of cooling problems in a single rack pair is a failed valve actuator. If the valve voltage is high but the cooling is not working, the actuator has probably failed. Less likely is multiple fan failure. In any case you will need to contact a central systems EH expert (see 12.11) for diagnosis and repair.
  4. Some rack pairs may be operated with failed cooling by opening all four rack doors. This will not work for racks with dense, high powered, equipment and with rack-high vertical air flow. These include the EMC LV (1-4), the DAQ (17-28),the SVT LV (29-32), and others with CAEN supplies. Racks that may be operated with open doors are those containing workstations, switches, or monitoring crates. Racks on the EH roof may be operated this way only when the hall temperature is below 23°C. If the power has not already tripped due to temperature in a high powered rack, but the temperature is still rising, it is best to turn off the high power equipment to prevent the AC power trip of many racks. This will cause the affected system to go non-runnable and the run will pause.
- Many rack pairs are giving warnings or are out of tolerance: In this case there is probably something wrong with the source of rack cooling water. Check the status of EH heat exchanger, which is best done via EPICS. (CEN→EH Cooling→Heat Exch.) If EPICS is down, go to the top of the EH.

1. First see that the pressure delta of the rack water (rack CWS-CWR) has an absolute value greater than 15 PSI and that the EH rack supply (rack CWS) temperature is less than 18°C.
2. If the pressure difference is low, check that at least one of the pumps is running.
3. If a pump is running, and the pressure is low, there may be a leak in the cooling system. Check for water under the floors.
4. For problems in the heat exchanger or rack water cooling system, contact a central system EH expert (see 12.11).
5. If the pressures are OK, but the temperature is high, check the chilled water pressure delta (EPICS) or return pressure (EH roof), and chilled water supply temperature. The absolute pressure delta should be greater than 20 PSI, the return pressure should be greater than 50 PSI, and the supply temperature should less than 10.5°C.
6. If the pressure is low the chiller pumps on the utility pad may be off.
7. If the temperature is high, the chillers may be off. The utility pad is next to the ring road between the Klystron supply building and the gas shack. For chiller and chilled water system problems, call the HVAC technician.

Electronics House Rack-Water/Dewpoint Alarm

A sensor has detected that condensation has begun to form on the EH rack cooling water supply pipes. This happens when the ambient dew point exceeds the temperature of the water. The usual action is to raise the rack water regulation temperature a degree using the PID controller in EH heat exchanger. The PID controller is located waist high at the north side of the EH heat exchanger. The heat exchanger is in the North East corner of the EH mezzanine. The PID instructions are located to the right of the box on which the controller is mounted. Raising the rack water temperature may result in some over-temperature warnings in the racks. These may be ignored as long as the temperatures remain close to the warning levels. If this does not resolve the problem, call a central system EH expert (see 12.11).

"RUBBER DUCK" (EH Water under the floor) Alarm

This Alarm indicates that water has been detected under the floor of the EH on either level. It is implemented with InspecTek water sensing cable.

1. Check the InspecTek panel that is in the EH in the top rack 11.
2. If the problem is a broken sensor, inhibit the matching SIAM channel in the CEN:ILK crate in rack 9 and log the occurrence.
3. If the problem is reported as water, then verify the problem:
   (a) Check for water level under the floor of the EH both inside and on the roof.
   (b) check the pressure in rack water circuit of the EH heat exchanger.

4. If none of the above explains the problem, assume (nervously – with trepidation) that this was a false Alarm.
   (a) Note the problem in the logbook so it will get fixed next day shift, and others know that it occurred.
   (b) Keep your eyes open in case the problem was real.
5. If you have confirmed the problem, report it to the Hall Manager and/or a central system expert.

Trip Overrides

If the SIAM-driven trip mechanism is overridden (rack 6, top back) for one or more zones, the CEN EH annunciator panel alarm will be set. There is also a disable for all shunt trips (including VESDA) and bypasses for the UPS contacters located in a breaker panel on the east side of the EH. These will also cause an EH alarm.

To fix a trip override, disabled, or bypassed alarm, fix whatever problem motivated the override, disable, or bypass, verify that all trip conditions are cleared (SIAMs), then un-override, enable, un-bypass as needed.

21.4.2 Electronics House Rack Water Alarm

The water for the Electronics House rack heat exchangers is cooled by a heat exchanger on the electronics house roof. Thermometers check the temperature of the outlet (Rack Water Supply) water and triggers this alarm when a certain threshold is exceeded. A differential pressure switch serves as a surrogate flow fault detector. This can also trigger this alarm.

1. If there is a flow fault, check that the heat exchanger pumps are on. If not, try to turn them on. Although they are normally both on, one should be sufficient. If they cannot be turned on, contact the central electronics people, starting with the BaBar lead electronics technician.
2. If there is also a central chiller alarm, take care of this first. See subsection 21.4.6.
3. If the flow is OK and the chilled water is OK, but the rack water temperature is not, then there is a problem with the temperature regulation. The problem is either the thermocouple, the valve controller (make sure it is powered), or the valve actuator. Contact the central electronics people, starting with the BaBar lead electronics technician for assistance.
4. While waiting, check the ambient temperature inside the Electronics House racks. Remember at 35 degrees C (varies somewhat between racks, see the labels in the back of the racks), the over-temperature interlock will shut off the rack power. This should be preceded by an early warning alarm. In racks with high power crates e.g. DAQ crates, the high power equipment should turned off if the rack temperature is close to the trip point. Racks without high power equipment can be kept from tripping by opening the doors both front and back.

21.4.3 IR-2

This alarm indicates a problem in the IP area. It is driven by the SIAM in CEN:MON (lower half of rack 9). Currently the only input is the rubber duck.

"RUBBER DUCK" (IR-2 Water) Alarm

This Alarm indicates that water has been detected on the floor of the PEP IR2 Hall. It is implemented with InspecTek water sensing cable.

1. Check the InspecTek panel that is in the EH in the top rack 11.
2. If the problem is a broken sensor, inhibit the matching SIAM channel in the CEN:MON crate in rack 9 and log the occurrence.
3. If the problem is reported as water, then check the InspecTek sensing heads in the front-bottom of EH rack 12. If the leak light is off, but the reset button/light is on, push the reset button. This should clear the alarm. Reset the SIAM and note the occurrence in the electronic logbook.
4. If the leak light is on, report the problem to MCC. An access will be necessary to investigate the cause, and to correct the problem.
5. If the water spill is benign or the alarm false, you may inhibit the SIAM channel.
6. Once the water leak is corrected and the sensor cable has dried out, reset the InspecTek head in the bottom-front of EH rack 9. The sensor is dry when the leak light is out. Reset the SIAM channel, and then remove any inhibit which may have been set.

EMC LP rack water Alarm

This Alarm indicates that water has been detected on the floor of the EMC LP rack (B620D-03) on top of the detector. It is implemented with InspecTek water sensing cable.

1. Check the InspecTek panel that is in the EH in the top rack 11.
2. If the problem is a broken sensor, inhibit the matching SIAM channel in the CEN:MON crate in rack 9 and log the occurrence.
3. If the problem is reported as water, then check the InspecTek sensing heads in the front-bottom of EH rack 12. If the leak light is off, but the reset button/light is on, push the reset button. This should clear the alarm. Reset the SIAM and note the occurrence in the electronic logbook.
4. If the leak light is on, report the problem to MCC. An access will be necessary to investigate the cause, and to correct the problem.
5. If the water spill is benign or the alarm false, you may inhibit the SIAM channel.

6. Once the water leak is corrected and the sensor cable has dried out, reset the InspecTek head in the bottom-front of EH rack 9. The sensor is dry when the leak light is out. Reset the SIAM channel, and then remove any inhibit which may have been set.

21.4.4 Gas Mixing Shack

If the Gas Mixing Shack indicator goes red, the gas shack safety control system has detected one or more of the following faults:

1. A problem with the gas shack ventilation (the GMS Vent alarm will be on)

2. A Hazardous Atmosphere Detector (HAD) has sent an alarm indicating a possible leak of isobutane

3. A smoke detector has detected smoke in the gas shack

4. Low pressure in the IFR or DCH isobutane lines into the shack has been detected; this could be indicative of a breakage in the lines

5. The IFR gas mixing system has developed a problem (the IFR gas alarm will be on)

6. A power outage in the gas shack may have occurred (the GMS vent, IFR gas, and probably the DCH gas alarms will be on)

In response to the fault(s) the safety system shuts off the isobutane to the IFR system, or to the DCH system, or to both.

A quick overview

Isobutane and inert gases are mixed in the shack to provide the gases for the DCH and IFR. Isobutane is stored on the west side of the shack; inert gas is stored on the east side. A leak of gas inside the shack could lead to the possibility of a fire or asphyxiation. The building relies upon its ventilation system to provide an essential safety function: the fresh air that is pulled into the shack by the ventilation guarantees that there is a dilution (via fresh air input) of any potential leak of gas in the interior of the shack to levels well below those dictated by safety concerns. We have instrumented the shack so that a significant drop in the fresh air coming into the shack (normally 600 cfm) or the air circulating in the shack (normally 2800 cfm) will shut off the isobutane going into the shack. Hazardous Atmosphere (HAD) sensors monitor the inside of the shack and the isobutane storage area for the presence of isobutane, and will likewise shut off the flow of isobutane into the shack. If the ventilation fails, you should not enter the gas shack unless there is a good reason and you have a HAD/ODM monitor and know how to use it. If there is a suspicion of an isobutane leak, you need to be certain not to take a chance of igniting it. Don't operate switches or anything else that could produce a spark. Again, you should have a HAD/ODM monitor and know how to use it if you go to the gas shack area.

The response

You need to find out what has caused the alarm, what system(s) have been shut off, and to contact the appropriate experts. At all times, you can call the EFD cryotechs at x5160 for help. The information you get from the Epics displays will be important to diagnose the problem before anyone goes to the gas shack. Call the gas system experts for the systems affected by the alarm. The number for the phone in the gas shack is x3367.

Experts on the operation of the gas shack are: Bob Messner, x2933, page 849-9547 (home phone 650-726-6928); for the HAD sensors, Ron Badger (EFD) (email or telalert to EFD-HAD), or Jim McDonald (EC); the IFR and DCH gas system managers; and the HVAC group (call MCC at x2151 to get a current page number, or try the pager for Marvin Jones, 570-8811.)

1. Bring up the Gas Mixing Shack Main Display Panel (right click on the CEN button on the main panel, or click the GMS button on the alarm panel) to determine what is causing the problem. The collar colors will probably identify the problem area immediately. If so, go immediately to the appropriate item below:
   (a) Go to the GMS Vent page. Note if any of the ventilation monitors MH1 through MH6 have tripped
      i. MH1 through MH4 monitor the air flow circulating in the gas shack. Any one of these will shut off the IFR and the DCH isobutane
      ii. MH5 is not used - it should not trip
      iii. MH6 monitors the air flow in the IFR rack. This will shut off the IFR isobutane only
   (b) Go to the GMS HADs page, and look at the signals HAD1 through HAD8. Note if any of the sensors HAD1 - HAD8 have tripped; any one of these will shut off the IFR and the DCH isobutane
      i. HAD1 through HAD5 monitor the air circulating in the gas shack itself. The SIAM for one of these at a time may be inhibited if the fault is due to an error and not a high % LEL reading. If the LEL is greater than 20% the fire department will have already been called. Send someone to the Gas Mixing Shack to meet them. If there is a high % LEL reading, contact the gas system experts for both the DCH and the IFR, and summon the on-call cryotech.
      ii. HAD6 through HAD8 monitor the area where the isobutane is stored. The SIAM for one of these at a time may be inhibited if the fault is due to an error and not a high LEL. If the the LEL is greater than 20% the fire department has been called. Contact the gas system experts for both the DCH and the IFR, and summon the on-call cryotech.
      iii. HAD9 through HAD12 are special DCH sensors and do not cause the Gas Mixing Shack alarm to change state - they do affect the operation of the DCH, however, and a DCH system expert will need to be called. Note if more than one sensor in a group has tripped - this would be a strong indication of a serious isobutane leak.

(c) Go to the GMS VME SIAM 1 Diags page. Note if the DCH Isobutane Supply Press Very Low or the IFR Isobutane Supply Press Very Low have tripped. These monitor the pressure in the isobutane lines going into the shack. Either one of these will shut off the IFR and the DCH isobutane. Contact the appropriate gas system expert to get the system restarted.

(d) Go to the GMS VME SIAM 5 Diags page. Note if any of the IFR system faults have tripped. These monitor the operation of the IFR gas mixing system. This will shut off the IFR isobutane only. Contact the IFR gas system expert.

(e) Go to the GMS VME Crate page. A power outage will leave this crate turned off. This will shut off the IFR and the DCH isobutane. See to the power failure section.

2. The course of action depends on what problems have been indicated - the following list assumes that only one type of problem is the primary culprit. Obtain help by calling the cryotechs at x5160. If you are unfamiliar with the gas shack, definitely have a cryotech with you if you go up to inspect it. Bob Messner can be called for any problem.

   (a) MH1 - MH4: contact the HVAC group (HVAC stands for heating, ventilation, and air conditioning.) The isobutane to both the IFR and the DCH will be shut off. Both gas system managers should be called.

   You can verify the problem by going up to the gas shack and checking the status sign at the entrance. It will say 'OK to Enter' if the ventilation is functioning. Do not go into the shack if the ventilation is not working. A HAD/ODM monitor is required in such cases. If the ventilation will be off for a significant time, the gases into the shack should be shut off by an expert.

   (b) MH6: this monitors a fan that circulates air through the IFR rack. Normally the door to the rack is closed, so a fan is needed to provide ventilation within the rack. The isobutane to the IFR mixing system has been shut off. Call the IFR gas system expert. The fan will need to be fixed.

   (c) HAD1-HAD5: these monitor the interior of the shack, which is protected by the shack ventilation. The alarm will shut off the isobutane into the shack and the ventilation will clear out the flammable gas. Both the DCH and the IFR gas system experts should be called. The fire department has already been summoned.

   You can determine which HAD caused the alarm using EPICS or by going to the gas shack. In EPICS go to the HADs page (main→CEN→ GMS→HADs). A tripped SIAM indicates a source of the hardware alarm. The analog readout indicates the isobutane levels. Yellow negative values indicate a HAD fault. Positive red values are a warning (minor alarm) and a positive red alarm roughly corresponds to the SIAM trip.

   In the event that EPICS is not up, you can go to the shack and look through the window in the entrance door at the safety control rack. You will see four large round Magnehelic faces, two per chassis, at the top. (These monitor the ventilation.) Below these is the safety control panel; lower still are four rows of black rectangular HAD controller displays, twelve in all, numbered from HAD1 to HAD12.

The source of the leak needs to be found and corrected. Contact the duty cryo-tech and the gas system experts.

(d) HAD6-HAD8: these monitor the isobutane storage area on the west side of the shack. The alarm will shut off the isobutane flowing into the shack; both the DCH and the IFR gas system experts should be called. The storage area is protected only by the natural ventilation in the area. You should have a HAD/ODM sensor with you to warn you of the presence of isobutane as you approach the shack. Stay away from the storage area if there is any indication of escaping isobutane. Isobutane is normally a colorless gas; if enough escapes from a leak, it will be cold and form a cloud.

The fire department has been called. Keep people away from the area. The valves on top of the isobutane bottles should be closed by the cryotech if the leak is small enough that it would be safe to do so. The isobutane needs to be diluted in air below the flammable point before the area is safe.

(e) DCH Isobutane Supply Press Very Low or IFR Isobutane Supply Press Very Low: either one will shut off the IFR and the DCH isobutane; call the IFR and the DCH system experts. The isobutane supply to one of the systems has run out. This could be due to damage to the supply lines, an empty bottle of isobutane, or another fault shutting off the isobutane supply.

The cryotech should go to the gas shack with a HAD/ODM monitor and verify the integrity of the isobutane supply lines.

(f) HAD9-HAD10: these are located in racks 9 & 10 on top of the detector and monitor the isobutane in the DCH bulkhead flush gas. They are actually part of the DCH gas system.

(g) HAD11-HAD12: these are located in racks 9 & 10 on top of the detector and monitor the air on top of the detector They are actually part of the DCH gas system.

(h) IFR system faults: the IFR gas mixing system has encountered a problem. See the IFR gas alarm section 21.9.1. Call the IFR gas system manager.

(i) If there has been a power outage, the gas shack safety system will need to be reset. There are two crates in the gas shack for you to turn on. One is in the gas shack rack near the door. You can reach in past the locked door and switch it on by hand if EPICS is not yet running. The other crate is the DCH control rack. Follow the instructions on the IFR gas mixing rack to reset that system. Call the DCH gas system manager.

21.4.5 Magnet

There is a problem with either the large super-conducting solenoid or the bucking coil. Data acquisition should cease immediately. More details may be found on the magnet

EPICS display panel, which may be reached from the odc_main→CEN page. If the solenoid has a cryogenics problem, the cryo-techs should have been automatically paged. Power supply problems are the responsibility of the power conversion group. Contact MCC.

If the solenoid has ramped down, the bucking coil will need to be ramped down and then back up after the solenoid has been ramped back up. This is the responsibility of MCC, but you should remind them if they forget. If the bucking coil is left at full field while the solenoid is down, there will be warning alarms complaining about the magnetic field inside the DRC shield. These are merely annoying as long as the above procedure is followed upon restoration of the fields.

21.4.6 Central Chillers

There is a problem with chilled water supplied by the central IR2 chilled water plant. This plant is on the IR2 utility pad which is next to the ring road, between the gas mixing shack and the power supply building. Chilled water problems will affect cooling for the EH racks, the DCH, DRC, and EMC FEE, the IFR flux return, the building 621 air conditioning, and the He liquefier.

There are two failures which will trip this alarm. One is a low pressure difference between the chilled water supply and return at the EH heat exchanger. This is tantamount to low flow, probably for all systems. The other is a high chilled water supply temperature at the EH heat exchanger. These two causes may be differentiated by looking at SIAM 1 in the cen-mon crate. In either case the HVAC people need to be called as soon as possible. See section 12.14.

This is an urgent problem. While there is no danger to the detector, many systems will soon shut down. Data acquisition will not be possible for long. If the EH rack water temperature begins to rise, shut down high power systems in the EH racks to avoid an AC power trip due to rack temperature. The critical devices are the EMC LV (racks 1-4), the CAEN supplies (various racks, inside and on the mezzanine), the DAQ crates (14-28), and the workstations (various racks, inside and on the mezzanine). Open the doors to all racks. Contact the system people to get help restoring operations.

21.4.7 Backup Cooling System (BCS) LCW

This alarm indicates a problem with the LCW half of the Backup Cooling System (BCS). It is generated by CEN-MONA SIAM_3, which is located in rack 9, CEN-mon, slot 15. If the LCW side of the BCS is not in use, inhibit channels 1 through 3 on this SIAM. This may be done on the EPICS panel odc_main→experts→SIAMS→CEN_MONA:3 , or directly on the front panel of the SIAM.

If the BCS LCW is in use, then this alarm is warning you of a problem. Contact a BCS expert 12.11.

21.5 SVT Alarms

The SVT alarm is a system summary. It means that some SVT power supply has been turned off. This may be because the environment is out of tolerance or the cooling is off.

Note that turning the cooling off is the normal procedure after turning the power off. See the alarm handler and the appropriate EPICS alarm section (22.4).

21.6 DCH Alarms

21.6.1 DCH High Voltage Trips

See the section under Drift Chamber High Voltage (22.5.1).

21.6.2 DCH Gas System Alarm

A gas system alarm is set by the "nanoautomate" alarm handler in response to a variety of different conditions. The specific cause can be determined using EPICS, as discussed below. The nanoautomate will attempt to place the system in a safe state, which may include stopping the gas flow, disabling the high voltage, and turning off the electronics power.

In response to an alarm, it may be useful to go to the gas hut (B636) after you have checked the history using EPICS.

1. Check that the chamber pressure is stable and approximately 4 mbar by checking the panel meter in rack B636-02 in the gas hut or by using EPICS:
   DCH → Gas System → Experts → Control Panels → Pressure Panels.

2. The current status of the alarm inputs is indicated by the LED status lights at the top of racks B636-02 and B636-04 and the corresponding EPICS panels:
   DCH → Gas System → Experts → Panels → Alarm Status Panel.

   Under normal running conditions, "C4H10 Not Present" is red and all others are green.

   Because of the response of the nanoautomate to the alarm, the current status is usually not helpful in diagnosing the cause. It is more informative to check the history of the status lights for the 33 seconds prior to the start of the alarm:
   DCH → Gas System → Experts → Panels → Last 93 seconds before the Alarm.

   The "3 second" panel will show the inputs at the time of the alarm (the nanoautomate has a delay of at least 5 seconds before it enters alarm mode), while the "33 second" panel should reflect the selected mode prior to the alarm. Flip back through the panels to isolate the transition that caused the alarm.

3. Contact the gas system expert by paging 377-9893, or by checking the complete phone list in section refdchexp in "How to Call a BaBar Expert."

4. If directed to do so by the expert, restart the system following the "Recovering from a Gas Alarm" checklist. Complete the checklist and file in the binder in the gas hut.

5. After the problem is fixed and the system is back in running mode, reset the annunciator panels in the control room and the electronics house, and reset DCH SIAMs 0 and 3 (if necessary).
   Safe → *DCH SIAMs* → *SIAM 0* or *SIAM 3*.

21.6.3 DCH Chiller Problem

This alarm indicates that the chiller, which provides cooling water to the drift chamber electronics, is not functioning correctly. Either there is no water flow, the temperature is wrong, or water has been detected in the bulkheads at either end of the chamber. The drift chamber HV or electronics power is turned off in response to the alarm.

1. Identify the source of the alarm by examining SIAM 2 in rack B620B-10 in the electronics house. (The SIAMs are labeled from 0). The table below summarizes the meaning of each input, the other SIAM channels that are expected to also trip, and the consequences of the alarm.
   (a) If the alarm is due to moisture in the rear bulkhead (input 4), check the panel meter in the "environment panel" in rack B620B-10. If it displays "EE" the problem may be due to a bad connection.
   (b) If either moisture sensor (inputs 4 and 5) has tripped, it might be useful to verify that the dry gas that flushes the bulkheads is still flowing. The rotameters are located in the back of rack B636-02 in the gas hut, and are labeled "forward" and "rear". Both should have flows of at least 10 cubic feet per hour.
   (c) If the alarm is due to low flow (SIAM 2 input 6, SIAM 3 input 3, or SIAM 4 input 0), check the status lights on the chiller front panel.
      - The chiller is located on the floor of IR2 near the wall directly opposite the entrance to the IR from the electronics house.
      - If the Main Flow red LED is illuminated, the pump has stopped; press the "pump on" button for 30 seconds maximum or until all the green LEDs on the panel are lit.
      - If pressing the "pump on" button for 30 seconds does not reset the chiller, or the alarm is due to temperature (SIAM 2, channel 1, SIAM 3 channel 4, or SIAM 4 channel 1), proceed to 2, below.
2. Contact an expert.
   (a) Jim McDonald x3644, page 846-9937
   (b) Karl Bouldin x2589, page 377-9893
3. After the expert has fixed the system, verify that all SIAMs are reset and that the annunciator alarm in the control room is reset.

Inputs of DCH SIAM 2.
The other SIAM channels that are expected to have tripped ("SIAM # - Ch #") and

the consequences of the trip are listed. "LV down" means that the DC electronics power supplies are set to 0 V; "LV off" means that the power supply is shut off.

Ch	*Description*	*Other SIAM Trips*	*Result*
0	Chiller Temperature	3-4	LV down
1			
2			
3			
4	Moisture, rear bulkhead	0-2, 3-2	HV off, LV down
5	Moisture, front bulkhead	0-1	HV off
6	low outlet flow	3-3	LV down
7	low chiller flow/temp	4-0	LV off

21.7 DRC system Alarms

21.7.1 Introduction

Two DRC hardware alarms are visible in the BaBar 'Beta' annunciator panel: the DRC Cooling Water Alarm and the DRC SOB Water Alarm.

21.7.2 The DRC Cooling Water Alarm

Description

The DRC front end electronics are located inside the magnetic shielding. They dissipate about 10 kW in this closed volume and therefore needs cooling to operate properly. *Note that no cooling is required when the doors are open; as cooling pipes are fixed on the internal side of the doors the cooling water is indeed unefficient when doors are opened!* The cooling is provided by water circulation inside heat exchangers located in close contact with the electronic crates. The Power supply distribution to the crates is interlocked to the chiller: therefore, a chiller failure shuts down the front end crates immediately. To keep the crates ON when the chiller is turned OFF, a drc-mon SIAM channel must be inhibited in the E.H. *Unless you really know what you're doing, this shouldn't happen with doors closed!*

Normal operating conditions

The 15°C. water is provided by the DRC NESLAB chiller located along the south wall of IR2. In normal conditions, the temperature inside the shield is between 25 and 30°C. The front-end crates temperature alarm is set at 35°C. The normal flow rate is around 6.5 Gal/minute and the water pressure 1.5 kg/cm**2.

What to do in case of alarm

Make sure that the alarm is true: go in the hall and check the status of the DRC chiller.

- ON/OFF status?
  Look at the LED on the chiller front panel. If it is simply switched off, switch it

on. Check that temperature and flow setting are OK (see below). Inform the DRC oncall expert (pager 846-0545) that the chiller has been found OFF.

- Is the temperature set correctly?
  Press on the LAST button on the front panel until you see the temperature setting and reading back. They should read 15 +- 1°C.

- Is the flow rate OK?
  Press on the LAST button on the front panel until you see the flow rate. It should read 6.5 +- 0.7 gallons/minute.

- Finally, read the pressure on the gauge on the right side of the chiller. Its nominal value is 30 +/- 15 PSI.

If any of these settings is incorrect page the DIRC on-call expert who may then contact HVAC (Heating, Ventilation and Air Conditioning, see section 12.14 for details).

Are the front-end crates really off?

Check on the EPICS display that the crates are indeed all off. From the main BaBar EPICS panel, click on DRC to get the DRC summary panel. Click on the Wiener Crates 'More' box (it should have a red frame if the crates are OFF). This opens the DRC FEE Status panel. For each sector, several monitoring data (voltage, temperature, FINISAR status) are available and you can get more information on a particular sector by clicking on the 'FEE' (front end electronics) and 'WCR' (Wiener crate) buttons. If one sector is off, all its parameters should be red (in alarm) or white (not connected). If the chiller is OFF and the doors closed, the front-end crates should not be kept ON. If they are still ON, shut them OFF by clicking on the buttons at the bottom of the panel (either crate-by-crate or by using the global OFF button). Note the temperature of the crates at the time you shut them off.

If EPICS is not available at that time, page the DRC on call expert.

Alarm recovery

Once the chiller is put back in operation, put the crates on using the EPICS display (by pressing on the AC-ON button, see above). Do not forget to reset the drc-mon SIAM if it tripped when the chiller went off.

Check that the temperatures are OK on the EPICS panel (between 25 and 32°C)

21.7.3 The SOB water alarm

The DRC Stand Off Box (SOB) is filled with ultra-pure water to improve the photon collection efficiency. There may be leaks of water into the detector through the DIRC quartz bar boxes. This constitutes a potential risk for the EMC CsI crystals since the bar boxes are not designed to be water-tight. If a leak is detected, the SOB water is dumped quickly (5,000l in $\tilde{4}$ minutes).

A real Beta alarm would indicate that water has been detected by more than one DRC water leak sensors *and* that the water in the SOB has been dumped. Refilling the SOB would take about 10 hours.

If that alarm shows up:

- go to Rack 38 on top of the electronics house. Look at the DIRC water leak panel and record the names of the channels whose lights are yellow or red – a green light means that the corresponding sensor output is OK.
- If the detector is accessible, go inside the BaBar hall and look around to see if there is some humidity, a visible water leak or a significant amount of water on the floor under the DRC magnetic shield.
- If you're quick enough, check that water is draining in the large 8 inch diameter pipe made of white plastic. It takes 4 minutes to drain the SOB.
- Contact the DRC oncall expert if it is not already done.

In case of a real SOB dump, a special procedure must be followed as quickly as possible to make sure that the release of ultra-pure water does not lead to an environmental hazard.

Alarm recovery

Once the expert has been called, he/she will try to find the leak and repair it if needed. This could take a long time but this step is mandatory: one cannot refill the SOB without having understood first why the water was dumped. Once the problem is fixed, the SOB will finally be refilled. This single operation takes approximatively 10 hours during which no good data can be taken.

21.7.4 Other phone numbers

The list of DIRC experts can be found in the dedicated section of the BaBar Care and Feeding Manual 12. If needed, you can also look at the DRC operations Web page.

21.8 EMC Alarms

21.8.1 EMC Bias Voltage Problem

An alarm from an EMC bias voltage channel is most likely caused by high beam background. This usually happens during injection. A channel or a group of channels may trip as well. This is a normal reaction by the power supply and is expected before any damage can be done by the high level of background.

In such conditions, the liaison should be informed of high background. If no trip is involved, the alarm should disappear when the background conditions improve.

If a channel or a group of channels is tripped off, the shifter should either:

- DO NOTHING. The tripped channels should recover by themselves when ramping is requested to take data.
- Press “Turn on tripped channels” button on the EMC bias voltage epics panel. This panel is brought up by clicking on “P” button next to bias voltage alarm on the alarm handler. Do this only when the background level subsides.

If a channel keeps on tripping off without a good cause, page the EMC commissioner immediately.

21.8.2 EMC Hardware Alarms

EMC hardware (annunciator) alarms are tied to the workings of chillers. These alarms are crucial to the safety of EMC crystals and electronics and therefore must **not** be ignored.

There are three EMC hardware alarms:

Hardware Alarm	Possible malfunction in...
EMC Barrel Status	Chillers related to Barrel operation
EMC Endcap Status	Chiller related to Endcap operation
BCS Fluorinert	BCS fluorinert system

BCS hardware alarm is applicable **ONLY** when BCS Fluorinert part is in operation. This alarm is not as severe as the other hardware alarms; however, contact the EMC commissioner and/or BCS expert immediately. No further action is needed as long as this is the only EMC hardware alarm.

For EMC Barrel and EndCap Status alarms, the shifter **MUST** follow the steps below:

1. Identify which hardware alarm (Barrel or EndCap?)
2. Verify that the corresponding power supplies are **OFF**.
3. Page EMC commissioner

For further explanation on chillers, please read the following section.

21.8.3 EMC Chiller Problem

In order to achieve optimal operating conditions, the temperatures of EMC crystals and front-end electronics are maintained by chillers: two fluorinert chillers, one for barrel crystals and diodes and another for endcap crystals and electronics, and one water heat exchanger (a.k.a. water chiller) for barrel electronics. A backup fluorinert chiller (a.k.a. spare chiller) also exists to replace barrel, endcap or both fluorinert chillers in case of a failure. The Backup Cooling System (BCS) can also be used to replace a function of the water chiller and/or (a) fluorinert chiller(s).

To prevent uncontrolled dangerous temperatures during a chiller outage, the power supplies to electronics are shutoff automatically by SIAMs. The following table summarizes the four SIAMs used by EMC:

SIAM Name	SIAM #	Function	Alarm output to...
Barrel	SIAM 1	Barrel Status	Hardware Alarm Barrel Power Interlock
EndCap	SIAM 0	EndCap Status	Hardware Alarm EndCap Power Interlock
Spare	SIAM 3	Spare Chiller Status	Barrel SIAM & EndCap SIAM
BCS	SIAM 2	BCS Fluorinert Status	Hardware Alarm

A chiller malfunction that directly affects the safety of EMC generates a hardware alarm. Please follow the steps in section 21.8.2 in case of a hardware alarm. The following subsections explain the workings of each SIAM and the settings required to switch among the chillers.

Barrel SIAM

Two types of chillers are used to maintain the operating temperatures of Barrel crystals and electronics. A fluorinert chiller is responsible for the crystals and diodes, and the water chiller is responsible for the front-end electronics.

During a normal operation (default condition), the barrel fluorinert chiller and the water chiller are used. The spare chiller or BCS fluorinert can be used to replace the barrel chiller when needed. The water chiller can be replaced by BCS LCW circuit.

A malfunction of any chiller in use for the barrel is designed to trip the interlock on the barrel electronics and generate a hardware alarm. The following table shows each channel monitored by the barrel SIAM and the default inhibit settings:

Channel	Monitors...	Inhibit
0	Not Used	INHIBIT
1	Barrel Compressor	NO
2	Barrel Flow	NO
3	Barrel Tank Level	NO
4	Barrel Temperature	NO
5	Spare Chiller	INHIBIT
6	Water Chiller Status	NO
7	BCS LCW Status	INHIBIT

EndCap SIAM

A fluorinert chiller is used to maintain the temperatures of EndCap crystals and electronics. During a normal operation (default condition), EndCap fluorinert chiller is used. The spare chiller or BCS fluorinert can be used to replace the EndCap chiller when needed.

A malfunction of any chiller in use for EndCap is designed to interlock the endcap electronics and generate a hardware alarm. The following table shows each channel monitored by the endcap SIAM and the default inhibit settings:

Channel	Monitors...	Inhibit
0	EndCap Compressor	NO
1	EndCap Flow	NO
2	EndCap Tank Level	NO
3	EndCap Temperature	NO
4	Spare Chiller	INHIBIT

Spare SIAM

The spare fluorinert chiller can be used to replace Barrel, EndCap or both chillers when in need. Under a normal operation, this chiller is turned off. As such, all the channels of the spare SIAM are inhibited.

In addition to monitoring the Spare chiller, the spare SIAM also monitors vital parts of the BCS fluorinert when in operation.

Channel	Monitors...	Inhibit
0	Spare Compressor	INHIBIT
1	Spare Flow	INHIBIT
2	Spare Tank Level	INHIBIT
3	Spare Temperature	INHIBIT
4	BCS Fluorinert Motor	INHIBIT
5	BCS Fluorinert Controller	INHIBIT

BCS SIAM

This SIAM is used to monitor the conditions of the BCS Fluorinert when in operation. A warning in any channel generates a hardware alarm. While the importance of these warnings cannot be understated, these warnings can be dealt with without interrupting the EMC operation. Since BCS Fluorinert is not in operation under a normal condition, all channels of this SIAM are inhibited:

Channel	Monitors...	Inhibit
0	BCS Fluorinert Controller	INHIBIT
1	BCS Fluorinert Tank Level	INHIBIT
2	BCS Fluorinert Bypass Too Long	INHIBIT

SIAM settings

In order to correctly monitor the operating chillers and connect the power supply interlocks to the right SIAMs, combinations of channel inhibits must be set correctly depending on the chillers in operation.

The following table of inhibit settings are used under normal operation (Barrel Chiller, EndCap Chiller & Water Chiller in operation):

Channels	Barrel SIAM	EndCap SIAM	Spare SIAM	BCS SIAM
0	INHIBIT		INHIBIT	INHIBIT
1			INHIBIT	INHIBIT
2			INHIBIT	INHIBIT
3			INHIBIT	
4		INHIBIT	INHIBIT	
5	INHIBIT		INHIBIT	
6				
7	INHIBIT			

The following table of inhibit settings are used when Spare chiller is in operation in place of barrel chiller (Spare Chiller, EndCap Chiller & Water Chiller in operation):

Channels	Barrel SIAM	EndCap SIAM	Spare SIAM	BCS SIAM
0	INHIBIT			INHIBIT
1	INHIBIT			INHIBIT
2	INHIBIT			INHIBIT
3	INHIBIT			
4	INHIBIT	INHIBIT	INHIBIT	
5			INHIBIT	
6				
7	INHIBIT			

The following table of inhibit settings are used when Spare chiller is in operation in place of endcap chiller (Barrel Chiller, Spare Chiller & Water Chiller in operation):

Channels	Barrel SIAM	EndCap SIAM	Spare SIAM	BCS SIAM
0	INHIBIT	INHIBIT		INHIBIT
1		INHIBIT		INHIBIT
2		INHIBIT		INHIBIT
3		INHIBIT		
4			INHIBIT	
5	INHIBIT		INHIBIT	
6				
7	INHIBIT			

The following table of inhibit settings are used when Spare chiller is in operation in place of both barrel & endcap chiller (Spare Chiller & Water Chiller in operation):

Channels	Barrel SIAM	EndCap SIAM	Spare SIAM	BCS SIAM
0	INHIBIT	INHIBIT		INHIBIT
1	INHIBIT	INHIBIT		INHIBIT
2	INHIBIT	INHIBIT		INHIBIT
3	INHIBIT	INHIBIT		
4	INHIBIT		INHIBIT	
5			INHIBIT	
6				
7	INHIBIT			

The following table of inhibit settings are used when BCS Fluorinert is in operation in place of both barrel & endcap chiller (BCS Fluorinert & Water Chiller in operation):

Channels	Barrel SIAM	EndCap SIAM	Spare SIAM	BCS SIAM
0	INHIBIT	INHIBIT	INHIBIT	
1	INHIBIT	INHIBIT	INHIBIT	
2	INHIBIT	INHIBIT	INHIBIT	
3	INHIBIT	INHIBIT	INHIBIT	
4	INHIBIT			
5				
6				
7	INHIBIT			

The following table of inhibit settings are used when BCS LCW circuit is in operation in place of Water Chiller (Barrel Chiller, EndCap Chiller & BCS LCW in operation):

Channels	Barrel SIAM	EndCap SIAM	Spare SIAM	BCS SIAM
0	INHIBIT		INHIBIT	INHIBIT
1			INHIBIT	INHIBIT
2			INHIBIT	INHIBIT
3			INHIBIT	
4		INHIBIT	INHIBIT	
5			INHIBIT	
6	INHIBIT			
7				

If all of EMC chillers fail, BCS will need to take over. This obviously is a desperate situation. Set the following inhibits and pray (BCS Fluorinert & BCS LCW in operation):

Channels	Barrel SIAM	EndCap SIAM	Spare SIAM	BCS SIAM
0	INHIBIT	INHIBIT	INHIBIT	
1	INHIBIT	INHIBIT	INHIBIT	
2	INHIBIT	INHIBIT	INHIBIT	
3	INHIBIT	INHIBIT	INHIBIT	
4	INHIBIT			
5				
6	INHIBIT			
7				

21.9 IFR Alarms

21.9.1 IFR (RPC) Gas

- NORMAL OPERATION: The mixing system uses three mass-flow controllers to combine Argon and Freon 134A with a few percent of isobutane. These components flow into a buffer tank until the absolute pressure (“PT I Pressure Cycle Sensor”) reaches about 1600 Torr, after which valves close automatically to stop filling. Flow

from the tank to IR-2 continues uninterrupted. When the tank pressure drops again to about 1500 Torr, the appropriate valves open automatically to resume filling the tank.
The isobutane bottles are outside the building on the flammable-gas pad to the west side. The RPC valve panel is clearly marked. The Freon and Argon bottles are in the black rack on the inert-gas pad to the east, along with compressed-air bottles to operate the valves in the mixing system.

- POSSIBLE PROBLEMS AND FIXES:
  - INTERLOCK TRIPS (some Interlock Status light is on):
    - FILL OPERATION FAULT: Filling of the buffer tank is suspended due to input pressure or flow out of range (see appropriate interlock light). This could be spurious, or due to an empty gas bottle, etc. If the input pressure looks OK, reset the faults, starting from the left. Also reset tripped SIAM channels in rack B636-03 inside the front door (the lock combination is the building number) to restore panels to the isobutane solenoid valves. (Check the valve control panel higher up in the rack: "RPC valves" should have green lights indicating "Enables" and "Powered"). Use one of the pieces of green plastic hanging nearby to push the recessed "RST" button for each SIAM channel.
      NOTE: if PT I $<$ 1500, push the fill cycle "DISABLE" button before resetting as above, then push "ENABLE" to resume normal operation.
    - MIXED GAS OUTPUT FLOW FAULT: Could be spurious, or because a fill operation fault has persisted long enough for the buffer tank pressure to drop below about 900 Torr, stopping flow to IR-2. In this case, fill operation must be restored first (as above). Once the tank pressure is above the minimum, it should be possible to reset the output fault (and SIAMs).
  - AFTER A POWER OUTAGE: All interlocks will be tripped, and the red fill operation "Disable" button will be lit. First turn on the SIAM crate in rack B636-03, then reset all the RPC system interlocks starting from the left (if one doesn't reset, try again after doing others). Then go back to B636-03, reset the SIAMs (as above) and hit all the "Enable" buttons on the valve control panels. Finally, push the green fill operation "Enable" button on the RPC system. Check that normal parameters and operation (as described above) have been restored.

Usually if there is an IFR GAS TRIP that you are unable to recover, you have to call the IFR GAS experts. Remember that if the gas doesn't flow for more than 1 HOUR, IFR must be switched OFF. In this case, call the IFR commissioners.

21.9.2 IFR (LST) Gas

The LST gas system manual is provided in the LST Operations Web area. Resetting the LST gas system after a trip is addressed in the "cheat sheet."

Chapter 22

There is an EPICS Alarm

Using the alarm handler is described in section 7.2.

22.1 Responding to EPICS Alarms

The Alarm Handler (alh) is an EPICS client which monitors the alarm severity status of EPICS channels. There are four alarm levels reported by the Alarm Handler:

- ERROR - either the alarm handler cannot locate the IOC serving the channel, or that IOC is no longer communicating, i.e., the channel is "disconnected". This may just indicate that an IOC is rebooting, but it could indicate a more serious communication failure. INVALID alarms are indicated by a white box labeled "E". On other clients, this state will be reported as "INVALID".
- INVALID - The highest actual alarm level. It signals that a channel does not have a current value. This is usually because some data input source is not communicating. INVALID alarms are indicated by a white box labeled "V".
- MAJOR - Signals an error state that should be attended to immediately. Indicated by a red box labeled "R".
- MINOR - Signals a transient or persistent condition that should be monitored, but does not require immediate action. Indicated by a yellow box labeled "Y".

Currently, any alarm will initiate a beeping sound to alert the shifter. The alarm status for each group is displayed just to the left of the name. Alarms are always initiated by a single channel, but the alarm status is propagated to the highest level, including the small MAIN window.

To determine the source of an alarm, follow it down until you reach the root group and then click on that group. All of the channels in the group will be displayed in the righthand region of the main window. You may have to scroll down to see the source of the alarm.

If the channel label is not descriptive enough to determine what the problem is, look for a link to an EPICS panel ("P" button) either next to the channel name, or next to one of its parent groups. If no EPICS panel is found, and you feel that there needs to be one, send mail to me. In this situation, you will have to go to the main BaBar EPICS panel and try to find the source of the alarm by navigating the offending subsystems panels.

To acknowledge an alarm, click on the button showing the alarm status. If the condition that caused the alarm has gone away, the alarm indicator will disappear, if it has not gone away, the indicator will remain but the beeping should cease.

22.2 Central Electronics Alarms

22.2.1 SIAM alarms

Many of the central system alarms are generated by SIAMs in the CEN-MON, CEN-ILK, and CEN-CRY crates. Most of these are also reported via the alarm annunciator panel and are described in Chapter 21. Those that are not, are described below.

22.2.2 UPS

This minor alarm is activated whenever the UPS (Uninterruptable Power System) senses any kind of problem. This is usually a brief dip in the input power. The alarm should clear within five minutes. No action is required unless the condition persists for many hours, in which case the EFD electronics techs should be contacted. If you can't get hold of the anyone, call the maintenance company listed on the front of the unit. The UPS is located in North-East corner of the IR2 hall. The alarm may be evaluated by looking at the UPS problem history (chapter 16).

22.2.3 EH Heat Exchanger

The EH rack cooling water is cooled by the EH heat exchanger located on top of the EH. The temperatures and pressures of the primary (chilled water) and secondary (rack water) inputs and outputs are monitored. An alarm will be generated if critical values (temperatures, pressures, and pressure drops) go out of the specified range. Pressure drop is a surrogate for flow. Pressure is a surrogate leak detector. Values sufficiently out of range will cause hardware alarms (see 21.4.2). Diagnosis and response for EPICs alarms follows that given in that hardware alarm section.

Of particular interest is the rack water temperature-dew point difference, since this can occur simply because of the weather. This EPICS alarm indicates that condensation may form on the rack water cooling system components. This will eventually set off the hardware dewpoint alarm which causes a CEN EH annunciator panel alarm. This condition may be verified by checking for moisture on the rack water supply pipes on top of the EH. No action is required for a warning (yellow alarm) condition, this is just a heads-up. For an alarm (red alarm in EPICS) or a hardware (annunciator panel) alarm, the usual action is to raise the rack water regulation temperature a degree using the PID controller in the EH heat exchanger. The PID controller is located waist high at the north side of the EH heat exchanger. The heat exchanger is in the North East corner of the EH mezzanine. The PID instructions are located to the right of the box on which the controller is mounted. Raising the rack water temperature may result in some over-temperature warnings in the racks. These may be ignored as long as the temperatures remain close to the warning levels.

22.2.4 Rack cooling alarms

An EH rack cooling alarm indicates that the air temperature in one or more racks is too hot. Over temperature for a particular device in a rack will be indicated as an alarm for the relevant system. A single over heated EH rack pair is usually due to a problem with the actuator for the temperature control valve. Less often there may be an air lock in the cooling circuit or fan failures. If multiple racks are hot, the problem is usually with the rack cooling water itself. See the EH heat exchanger subsection (22.2.3) above. In either case, a hardware alarm will occur soon if it hasn't already. Follow the instructions for such alarms (section 21.4.1).

22.2.5 VME crate alarms

The VME crates are considered to be part of the central system and are monitored via CEN-MON. Temperatures, voltages, currents, status, and fan speeds are all watched. Power supply temperatures are prone to go into the alarm state if the crate is off, because the fans are then off. This will be reflected in the cooling display as well. This condition is of no significance. For other temperature alarms, use the cooling display (subsection 22.2.4 to try to locate the source of the problem. See the Common Electronics expert list in Chapter 12.11 for people to help. When a VME crate is simply disconnected from the CAN Bus, some alarms will go into alarm but not the invalid state. Using the Alarm Handler, one can see the reason for the alarm like <HIGH, MAJOR>. If a disconnected occurred, it would probably say <TIMEOUT, MAJOR>. Some other TIMEOUT errors occur when the CAN Bus is not given enough time to respond to the database queries.

Most of the VME Crates start warnings at 40 degrees C and alarms at 45 degrees C. VME Crates are designed to automatically turn off when the temperature exceeds some point (50 degrees C in the preliminary specification), a fan fails, or a power supply has gone bad.

22.2.6 IOC statistics alarms

The detector control VME crates (all 6U crates) have an EPICS IOC (MVME 177 single board computer) running the channel access program. These IOCs report back statistics on their operations. The status summary of these statistics is indicated by the vertical bar on the left side of the crate depiction in the VME crate display. Note that disconnected statistics channels will be summarized as a major (red) alarm on this display.

Although these statistics are reported in the central system, failures are nearly always due to some combination of the program and the system hardware. See the section below for the system involved. Contact the appropriate system detector controls expert if you don't make rapid progress.

A special case is an IOC that is hung or crashed. In this case all statistics channels will be disconnected (white), as will all other channels residing in this IOC. In this case the only solution is to reboot the IOC. For most IOCs no additional harm can come from this, but check the IOC boot table C and contact the relevant system people (except for the central system) anyway. See Chapter 18 for instructions.

22.2.7 HAD alarms

The Hazardous Atmosphere Detectors look for dangerous levels of isobutane. Dangerously high values will trigger hardware alarms and, in many cases, call the fire department. Warnings and indications of malfunction will cause EPICS alarms.

1. HAD1 through HAD5 monitor the air circulating in the gas shack itself. The SIAM for one of these at a time may be inhibited if the fault is due to an error and not a high % LEL reading.

2. HAD6 through HAD8 monitor the area where the isobutane is stored. The SIAM for one of these at a time may be inhibited if the fault is due to an error and not a high LEL.

3. HAD9 through HAD12 are special DCH sensors. They affect the operation of the DCH, and a DCH system expert will need to be called. Note if more than one sensor in a group has tripped, this would be a strong indication of a serious isobutane leak (vs a faulty sensor head).

1. HAD1-HAD5: these monitor the interior of the shack, which is protected by the shack ventilation. A major alarm will trip the SIAM, call the fire department, and shut off the isobutane into the shack. The ventilation will clear out the flammable gas. Both the DCH and the IFR gas system experts should be called. A lower level of isobutane or a HAD fault will cause an EPICS alarm. The question is: which has happened?

   You can determine which HAD tripped by using EPICS or by going to the gas shack. In EPICS go to the HADs page (main→CEN→ GMS→HADs). If the LEL reading is less than -3, its a HAD failure. If the reading is positive, its a gas leak.

   In the event that EPICS is not up, you can go to the shack and look through the window in the entrance door at the safety control rack. You will see four large round Magnehelic faces, two per chassis, at the top. (These monitor the ventilation.) Below these is the safety control panel; lower still are four rows of black rectangular HAD controller displays, twelve in all, numbered from HAD1 to HAD12. If a HAD controller display shows less than -3% or EE rather than a number, this means that the HAD sensor has failed a self-test, and is not working right. In this case, if channel for one HAD of 1,2 and two HADs of 3,4,5 repairs may wait until the next working day. Be sure to make an entry in the hardware trouble database. Email has been sent to the technician responsible for its repair.

   If the fault is not due to a faulty sensor, then the source of the leak needs to be found and corrected. Contact the duty cryo-tech and the gas system experts.

2. HAD6-HAD8: these monitor the isobutane storage area on the west side of the shack. High levels of isobutane will cause a major alarm which will shut off the isobutane flowing into the shack, set off the hardware alarm, and call the fire department. Both the DCH and the IFR gas system experts and the cryotech should be called. Lower levels of isobutane or HAD failure will cause a warning (minor alarm). The question is: which? The storage area is protected only by the natural ventilation in the area. You can check for a faulty sensor in the same manner as above. You should have a HAD/ODM sensor with you to warn you of the presence of isobutane as you approach the shack. Stay away from the storage area if there is any indication of escaping isobutane. Isobutane is normally a colorless gas; if enough escapes from a leak, it will be cold and form a cloud.

   If there is a significant leak, and there has not yet been a major alarm, then ask the cryotech to call the fire department (9-911), giving the gas shack location and explaining the nature of the problem. If it is between 7 AM and 7 PM on a weekend there will be no cryo-tech on duty. Call the fire department yourself. Keep people away from the area. The valves on top of the isobutane bottles should be closed by the cryotech if the leak is small enough that it would be safe to do so. The isobutane needs to be diluted in air below the flammable point before the area is safe.

   If there is no leak, that is, none of the above conditions exist and the HAD in question reads EE or a negative number, then there is a HAD self-test or calibration failure. If one of these three is working, repairs on the failed HADs may wait until the next working day. Be sure to make an entry in the hardware trouble database. The responsible tech has been notified automatically.

3. HAD9-HAD10: these are located in racks 9 & 10 on top of the detector and monitor the isobutane in the DCH bulkhead flush gas. They are actually part of the DCH gas system. These HADs normally read about between 0% and 4% of the LEL. A negative reading or EE indicates a HAD failure. Repairs on a failed HAD may wait for a maximum of 60 hours. The responsible tech has been notified automatically.

4. HAD11-HAD12: these are located in racks 9 & 10 on top of the detector and monitor the air on top of the detector They are actually part of the DCH gas system. A negative reading or EE indicates a HAD failure. If one of these HADs is working, repairs on the failed HAD may wait for the next working day or for a maximum of 60 hours, whichever is longer. The responsible tech has been notified automatically.

22.3 Magnet alarms

22.3.1 Solenoid

There is a problem with the either the solenoid. This is the province of either MCC or the Cryo crew.

22.3.2 Bucking Coil

There is a problem with the either the bucking coil. This is the province of MCC or power conversion.

22.3.3 Backup Cooling System (BCS)

Some aspect of the Backup Cooling system is out of tolerance.

The BCS is a pair of heat exchangers which serve as backups for the EMC fluorinert chillers, the EMC water chiller, and the DCH and DRC chillers. (The EMC water and DCH chillers are actually heat exchangers). The fluorinert side of the BCS is used to backup the barrel and endcap fluorinert chillers. The Low Conductivity Water (LCW) side of the BCS is used in positive pressure mode to backup the EMC LCW chiller and the DRC chiller, and in negative pressure mode to backup the DCH chiller.

Use the “P” button on the alarm handler to bring up the display for the alarming device. Check that the use status is set appropriately. If the system is in use, and there is a major alarm, contact a BCS expert 12.11.

22.4 SVT EPICS Alarms

The SVT Alarm Handler is automatically started by the ”startODC” command.This page contains information about the records that are displayed on the Alarm Handler and, in many cases, also the actual minimum/maximum values of monitored quantities. In general, alarms are generated when the monitored quantities are above or below some threshold. In most cases there are two high and two low thresholds, which can generate minor and major alarms.

There are two categories of SVT Alarms:

1. **Environmental alarms indicate the environment in which the SVT is operating is outside specs (eg temperature is too high).**

2. **Services alarms indicate that some of the required services for the SVT (e.g. cooling water) are malfunctioning.**

All the SVT Alarms are generated by the SVT Detector Monitoring and Control System and they can be traced to their source through the SVT Alarm handler. See section 7.2 for some general information about the alarm handler. Important considerations to bear in mind are:

- Alarm-generating devices are organized in a hierarchy and the most severe alarm status percolates up to indicate the whole hierarchy alarm status. There are 4 alarm levels with associated colors:
  - `INVALID`: white
  - `MAJOR`: red
  - `MINOR`: yellow

  - NOALARM: green

  The number of devices in each condition are counted through the hierarchy and summarized at any level with 4 numbers.

- An INVALID condition is considered more severe than a MAJOR alarm and will possibly mask it. **Always** check the summary numbers for the different types of alarms.
- Things you can do with an Alarm handler group:
  - Expand the hierarchy: click on the arrow on the right
  - Display the group composition in the right pane: click on the alarm name
  - Run the corresponding display panel: click on the P on the right.
  - Acknowledge the alarm: click the button on the left. **Careful**: when you acknowledge an alarm, it becomes your responsibility to do something about it.

However, in most cases the SVT Alarm Handler is set up in such a way as always to report a major alarm regardless of the type of alarm (major or minor). On the other hand, alarm conditions in the SVT Online Detector Control (ODC) epics panels use all available colors, including green to signal that everything is OK. The ODC panels use the same variables as the Alarm Handler.

The thresholds reported here are accurate as of August 10, 1999. Since the thresholds values are stored in epics records, you can easily check them by typing from the babasvt account:

```
cd /nfs/bbr-srv01/u1/babar/boot/apps/svt-all      source site/epicsSetup
caget VariableName
```

For example, to get the high-threshold for the major forward chiller temperature alarm, type (see below):

```
caget SVT:F:COOL:H2O_MANTEMP.HIHI
```

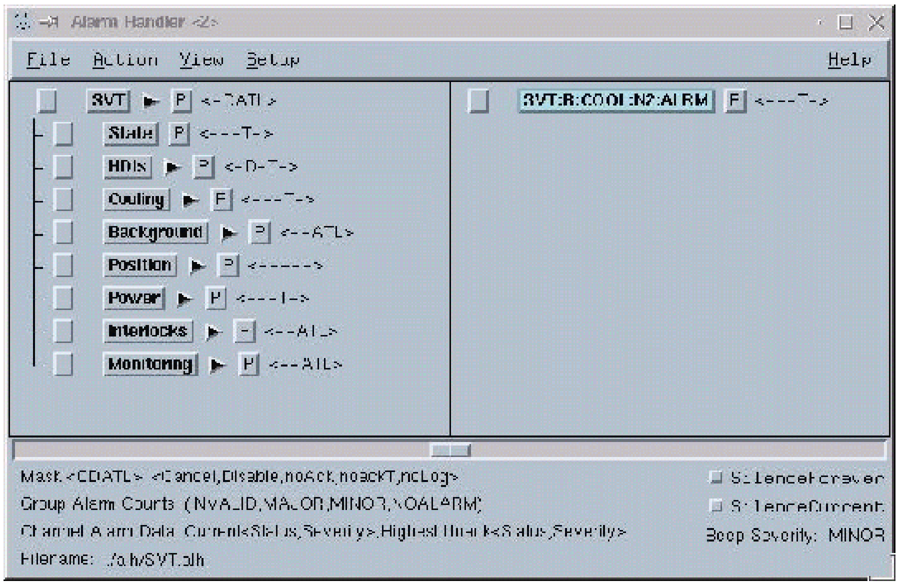
By clicking on the button you can open up the SVT Alarm Handler tree:

By clicking on the arrows you can travel down the component tree. If you have an alarm, the affected component will change color and the terminal will beep at you. You can acknowledge the alarm by clicking on the button on the left hand side of the quantitiy that is showing an alarm. You can silence the beeping by clicking on the buttons in the bottom right-hand corner of the window. Clicking on the "P" button will bring up the corresponding ODC epics panel. You can travel down the tree by clicking on the arrows. This allows you to find out what component caused the actual alarm. For more details on the operation of the Alarm Handler, see this.

The top level categories in the SVT Alarm handler are examined below. The next level down for all categories except Monitoring is Backward and Forward.

22.4.1 State

This is tied to the SVT State Machine. The box goes yellow during transitions between states, red if the State machine is in a fault state. Remember that when you are in a fault state the SVT is neither runnable nor injectable.



22.4.2 HDIs

The only variable connected to the HDI's alarm section is the HDI temperature. The temperature threshold settings are tied to the state within the State Machine, and are set by layer. To look at the threshold settings go to **Top Level Panel -> HDIs -> Temperature Status-> LxMx Module-> Ranges**. Note: This set of conditions, if not fulfilled, does not cause a State Machine fault. The reason is that otherwise transitions between states would take too long, as the HDIs warm up or cool down.

- `Category:` Environment
- `Source:` HDI Temperature Monitor `HTEMP`
- `Action:`
  - `INVALID:` means a loss of communication with the `HTEMP` module. Interlocks should still be working. Continue operation and call HTEMP expert (Chris Roat). Make sure that corresponding PS channel is being monitored. If the PS is not being monitored, it is likely that the interlock is not working.
  - `MAJOR:` means the HDI is over temperature. This should have turned the power supplies off. Verify that the affected power supplies are off through Epics. Check chiller status in Epics. If the problem is due to the chiller, go to the "Chiller not working" section. If you cannot solve problem call the HTEMP expert (Chris Roat). If the problem is understood and solved (NOT BY INTERLOCK BYPASS) reset SIAM, and power on by hand affected PS in Epics. Verify that the State Machine moves out of Fault condition.

Channel / COMMON	Major/HIHI	Minor/HIGH	Minor/LOW	Major/LOLO
Cooling circuit pressure $(P)_INPRES12, $(P)_INPRES3, $(P)_INPRES4, $(P)_INPRES5	>23 psia	>21 psia	< 5 psia	< 3 psia
Chiller Temp $(P)_MANTEMP	>15 degrees	>14 degrees	< 5 degrees	< 4 degrees
Return Pressure $(P)_RETPRESS	>12 psia	>10 psia	< 4 psia	< 3 psia
Vac Leak Rate $(P)_LEAK	>3.0 l/min	>0.5 l/min	<0.0 l/min	<0.0 l/min

22.4.3 Cooling

- `Category:` Services
- `Source:` Cooling and Nitrogen circuits
- `Action:`
  - `INVALID:` means a loss of communication with the cooling system. Interlocks should still be working. Continue operation and call chiller expert: Roy Kerth/Chris Roat
  - `MAJOR:` means the cooling temperature is out of limits. This should have already have tripped the corresponding HDIs. Verify they are off. Call chiller expert: Roy Kerth/Chris Roat

Let's spend a moment looking behind the scenes to put all the content in writing... Cooling is broken up into "Forward" and "Backward" followed by water monitoring ("H20") and dry air monitoring ("N2"). There are alarms settings that are common to all states, and alarm settings that are specific to the cooling state that the State Machine is in. The common alarm settings are shown in the tables below.

Water Monitoring ("H20")

- If any thresholds of the variables listed in the table below are crossed, the ALRM record will be in Major Alarm
- Records are defined on svt-mon in `/db/cool/H20_Monitoring.db`
- $(P) is a shorthand for SVT:F:COOL:H2O (forward) and SVT:B:COOL:H2O (backward).

The following settings are relevant for the Cooling ON state:
The following settings are relevant for the Cooling OFF state:

Channel / COOL ON	Major/HIHI	Minor/HIGH	Minor/LOW	Major/LOLO
Cooling circuit temperature $(P)_INTEMP12_CON $(P)_INTEMP3_CON $(P)_INTEMP4_CON $(P)_INTEMP5_CON	>13 degrees	>12 degrees	<5 degrees	<4 degrees
Water flow rate $(P)_INFLOW12_CON $(P)_INTEMP3_CON $(P)_INTEMP4_CON $(P)_INTEMP5_CON	>1.0 psia	>0.8 psia	<0.4 psia	<0.3 psia

Chanel / COOL OFF	Major/HIHI	Minor/HIGH	Minor/LOW	Major/LOLO
Cooling circuit temperature $(P)_INTEMP12_COFF, $(P)_INTEMP3_COFF, $(P)_INTEMP4_COFF, $(P)_INTEMP5_COFF	>30 degrees	>25 degrees	<5 degrees	<4 degrees
Water flow rate $(P)_INFLOW12_COFF, $(P)_INTEMP3_COFF, $(P)_INTEMP4_COFF, $(P)_INTEMP5_COFF	>0.05 psia	>0.01 psia	<-0.01 psia	<-0.01 psia

Channel / N2 MON	Major/HIHI	Minor/HIGH	Minor/LOW	Major/LOLO
Supply Flow $(Q)_SUPPLY	>12 l/min	>11 l/min	>7 l/min	<6 lt/min
Recirculation Flow $(Q)_RECIRC	>5 l/min	>3 l/min	NA	<0.1 l/min
Rel. Humidity (2 sensors) $(Q)_RELHUM1, $(Q)_RELHUM2	>100%	>30%	<2%	<0%
Temperature (2 sensors) $(Q)_TEMP1, $(Q)_TEMP2	>60 degrees	>40 degrees	<10 degrees	<0 degrees
Dew Point $(P)_DEWPNT	>3 degrees	>0 degrees	NA	NA

Dry Air Monitoring ("N2")

- If any thresholds of the variables listed in the table below are crossed, the ALRM record will be in Major Alarm
- Records are defined on svt-mon in `/db/cool/N2_Monitoring.db`
- $(Q) is a shorthand for SVT:F:COOL:N2 (forward) and SVT:B:COOL:N2 (backward).

22.4.4 Background

- `Category:` Environment
- `Source:` Radiation monitoring `SVTRAD`
- `Action:`

  The Background alarms summarize the operational state of the SVT's Radiation Monitoring and Protection System, SVTRAD. The Alarm Handler is used to flag and track error conditions that compromise the integrity of the SVTRAD system. As such, high background levels or beam abort caused by SVTRAD do not show as errors – they in fact prove that the system is operating as designed.

  There one is basic element in the ALH tree, the PIN diode (and its thermistor). You'll be able to see this in the ALH tree with the 12 instances of the PIN-Diode objects, sorted into four geometrical categories, FE, FW, BE, and BW, and then TOP, BTM, and MID.

  The individual diodes suffer alarms based on the conditions below. You can inspect whcih diodes are causing the Background alarm by visiting the SVT –¿ Background EPCIS panel and looking at the right-most column of rectangular (unlabelled) indicators. The RED lights indicate an error state. To obtain more information on the individual diode's error state, choose Details ==¿ (right click and drag down) Error Status and review the options there.

  - ABORT channel configurtaion error. (EPCIS and SVTRAD module do not agree. This is either because of an actual error in reading/writing the registers or EPICS is expecting the wrong default value.)
  - MONitoring ADC configuration error. (ibid)
  - Temperature read from thermistor out of range. (7.5 - 30 deg C)
  - Thermistor processing from HTEMP module carries a severity condition.
  - Diode is in an inconsistent STRICT / RLXD threshold state.
  - For ABORT diodes (typically the MID plane diode), the DIODE or THERMISTOR watchdog is alarming – a disconnected channel has been detected.
  - Error in dose rate computation, due to detected bad pedestals, temperatures, or configurations.

- To resolve error conditions, you should probably visit the SVTRAD troubleshooting page here and contact the SVT Commissioners.

22.4.5 Position

- `Category:` Environment
- `Source:` Capacitec position monitors between the SVT, B1 support cones, and support tube.
- `Action:` No alarm conditions have been implemented yet.

22.4.6 Power

- `Category:` Services
- `Source:` CAEN Power Supply System with different causes:
  - `HDI Power`
  - `MUX Power`
  - `CAEN Crates`
- `Action:`
  - `INVALID:` means a loss of communication with the CAEN Crates. BaBar must disable injection because this could be caused by a problem that prevents the switching off of the HV during injection (e.g. if the PS firmware has crashed). Next step is to check whether the problem is with IOC crashed, or if there is a problem with the SW internal to the PS. If only one crate is in alarm, it is likely to be a CAEN crate problem.

        * `CAEN Crate Not Responding:` The crate needs to be reset. There will be a control to do that from the Power Supply display. For the time being, you need to walk to the crate and manually reset it.
        * `IOC Not Responding` This will cause all the crates serviced by that IOC to be `INVALID`. It should reboot automatically, and after a while the communication should be re-established.

    If this problem arises, call the SVT expert.

  - `MAJOR:`
    * The **Major Alarm** is set for an overvoltage, undervoltage, Ext-Trip, Kill, or Trip error.
    * The **Minor Alarm** is set during ramp-up ramp-down.
    * in HDI Power or MUX Power section: means a power supply trip. If this is not connected to other problems (eg cooling), try to bring the affected channel back up through Epics. If the problem persists, call the SVT expert.
    * in Caen Crate means there is a comunication error with the SVT CAEN Power Supply Crates. For safety reasons you must immediately turn off all 12 SVT PS Crates located in racks 29-30-31-32 on the roof of the electronics house. Each crate has a key. The crate can be turned off by turning the key to the OFF position. Get in touch with the SVT expert-on-call immediately after having performed this operation.

- Records are defined on svt-lv in `/db/lv/HDIPS_Crate.db` and `/db/lv/MUXPS_Crate.db`
- The **Major Alarm** will be set for a Kill, Lock, Fan Failure, or Communication error.
- Records are defined on svt-lv in `/db/lv/SY527_Crate.db`.

22.4.7 Interlocks

- `Category:` Services
- `Source:` SIAM Interlock System
- `Action:`
  - `INVALID:` means a loss of communication with the SIAM System. You probably need to reboot the IOC.
  - `MAJOR:` means an interlock went off. This will be connected with either a cooling circuit malfunction or an HDI Over-temperature. After solving the cause, you need to reset the interlock from the Interlock panel.

22.4.8 Monitoring

- `Category:` Services
- `Source:` Various sources:
  - `CAN_bus`
  - `VME_Crate`
  - `Chiller_Racks`
  - `MUX_Racks`
- `Action:` In general, an alarm in the Monitoring section indicates a loss of communication with some device. This is **not** an acceptable way of running. In particular:
  - `CAN_bus` A CAN bus crash will prevent us from reading one or more of the following: HTEMP module, SVTRAD module, MUX Crate status, Position monitors. The first two are needed for running, the latter two have less priority. Try to identify exactly what portion of the CAN bus is not working (by using the top level SVT Screen to navigate to Monitoring/CAN) and call the relevant expert.
  - `VME_Crate`
  - `Chiller_Racks` May mean we do not have control over the chiller crates. Call the expert (Roy Kerth)
  - `MUX_Racks` If it is a `DAQ` alarm, it may be a bad DAQ/HDI link channel. Can it be seen in DAQ (OEP ?)? Needs replacement of DAQ/HDI link card. Inform Pilot to decide what to do about ongoing run. Discuss access with Pilot/ run coordinator. Call DAQ link expert (Monika Grothe).
  - If it is a `RAD` alarm, it involves the SVTRAD module. We may be losing the radiation monitoring capability. Call SVTRAD expert (Tim Meyer)
  - If it is a `TEMP` alarm, it involves the HTEMP module. We may be losing the temperature monitoring capability. Call HTEMP expert (Chris Roat)

22.5 The Drift Chamber EPICS Panels

22.5.1 High Voltage Control

Information provided by Masahiro Morii at
.../BFROOT/www/Detector/CentralTracker/operations/survival/#hvpanel.

Recovering from High Voltage Trips

To ensure smooth "factory" operation of the BaBar experiment, the Drift Chamber must recover from trips routinely, or our efficiency and integrated luminosity will be impacted. This process has been partially automated, for the situations (described) below, which are clearly understood as due to machine-related backgrounds.

There are two ways the the DCH can trip during normal operations, excessive power supply currents or repeated current spikes on single wires. We have software running on the DCH IOC (`DCH-MON`) which will automatically implement the instructions below, and recover from trips in 10-20 seconds.

Other kinds of trips (gas system interlocks, chillers, safety systems) are more dangerous and should be dealt with as with any alarm condition: **Page the DCH Operations Manager** at (650) 846–0981.

The DCH can also drop voltage briefly (up to five seconds) without tripping. This will appear as a *yellow alarm* in the Alarm Handler and on the DCH voltage and current indicators in EPICS. The shift leader does not need to take any action, but if it happens frequently, it indicates poor beam conditions.

1.	Bring up the DCH High Voltage Panel	
	Normal trip Status indicator shows *Tripped*	**"DCH Spike" trip** *[Spike Ack.]* is Red
2.	Take the DCH out of Global Control if necessary	Select *[Spike Ack.]* Panel
3.	Set the chamber to *[Injectable]*	*[Acknowledge]* the alarm
4.	Ensure that the BACKGROUNDS indicator is *green.* **You cannot put the chamber back in a [Runable] state if the background indicator is red.**	
5.	Return the DCH to Global Control. **You must reset the trip as described above before returning the DCH to Global Control.**	
6.	Record the trip in the logbook, along with any special conditions.	

Drift Chamber HV Status

When the high voltage trips, the first thing you need to do is bring up the DCH High Voltage control panel. From the main DCH panel (left) select the *[High Voltage]* button.

The HV control panel indicates the current state of the HV system. When it trips, the kind of trip will be shown in the box at the lower left. As noted above, there are two "routine" trip conditions from which the Pilot is authorized to recover from and continue operations: excessive power supply currents or repeated current spikes on single wires.

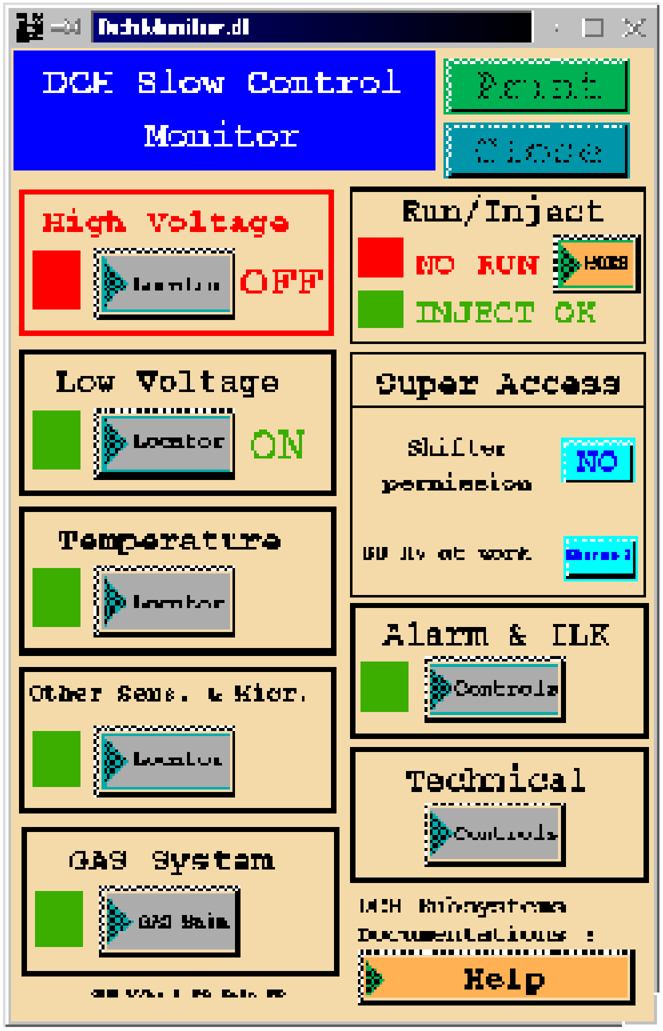
Over-current Trips

Our CAEN high voltage power supplies have been configured with current limits at approximately three times the level during normal running.

ALIGN=RIGHT¿

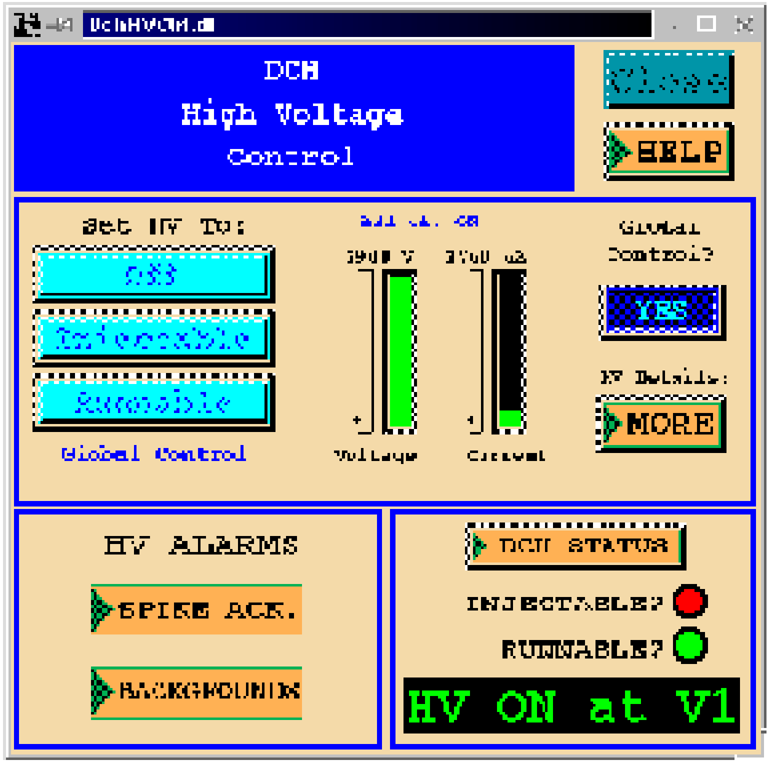
If the current on a channel exceeds the limit for more than five seconds, the CAEN will raise an error flag and ramp the voltage down in a controlled manner. High background conditions typically will trip several superlayers in a region, occasionally the whole detector.

These trips will generally be recovered automatically, as described above. If too many trips occur during a single fill, or during a run, the automated recovery is disabled. After



contacting the DCH Operations Manager you should reset this trip from the DCH HV Control panel.

1. Take the chamber out of "Global Control" with the blue Global Control *[Yes]* button.
2. Set the chamber state *[Injectable]*. This resets the trip condition on the CAEN power supply, and ramps all the channels to the same voltage. *NOTE: Turning the voltage* [Off] *does not reset the power supply.*
3. Ensure that the background levels are tolerable. The *BACKGROUNDS* indicator must be *green*.
4. Return the chamber to "Global Control." If the backgrounds are too high, this step will fail.



5. Record the trip and any special conditions in the logbook.

You cannot put the chamber back in a [Runable] state if the background indicator is red. This indicator summarizes the SVT "soft abort" diode readings, which dump the beams if they remain high for five minutes.

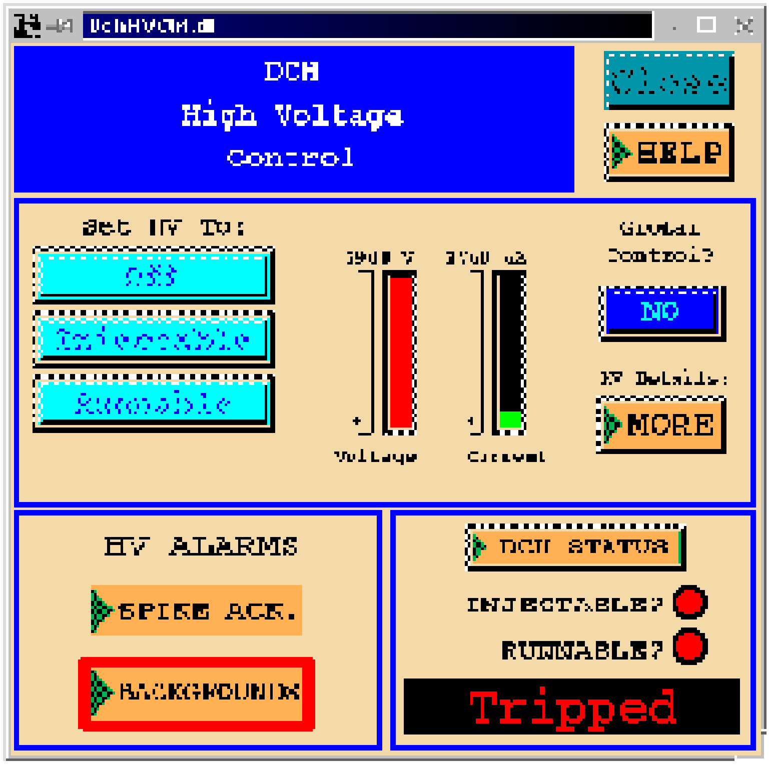
The DCH backgrounds summary panel shows the values for each of the four SVT PIN diodes (Forward East, Forward West, Backward East, and Backward West) and the limits set for the DCH. The values typically fluctuate around 20 during normal running.

The background limits ("DCH Pain Threshold" shown in blue) can be changed either by a DCH HV expert or by the BaBar shift leader. Under certain conditions, the SVT PIN diodes, especially Backward West, can experience a pedestal drift, so that their "normal" reading ends up significantly higher than our "Pain Threshold."

If this happens, and prevents running when the beam conditions are clean, the shift leader should raise the threshold for the problem diode. For example, Backward West could be raised to 100 or 1000, effectively removing it from the decision process. Once the SVT PIN diodes are recalibrated, the DCH pain threshold should be restored.

Automatic Trip Recovery

The automatic trip recovery consists of a single additional state in the dch-mon hv_control.st state machine. Any time there is a HV trip and the DCH is in global mode,



this state is entered. Below are the ways out of the state in roughly their order of priority. Returning to the state on certain steps ensures the priority is re-applied for each change in conditions.

DCH HV Trip Auto Recovery State initialization

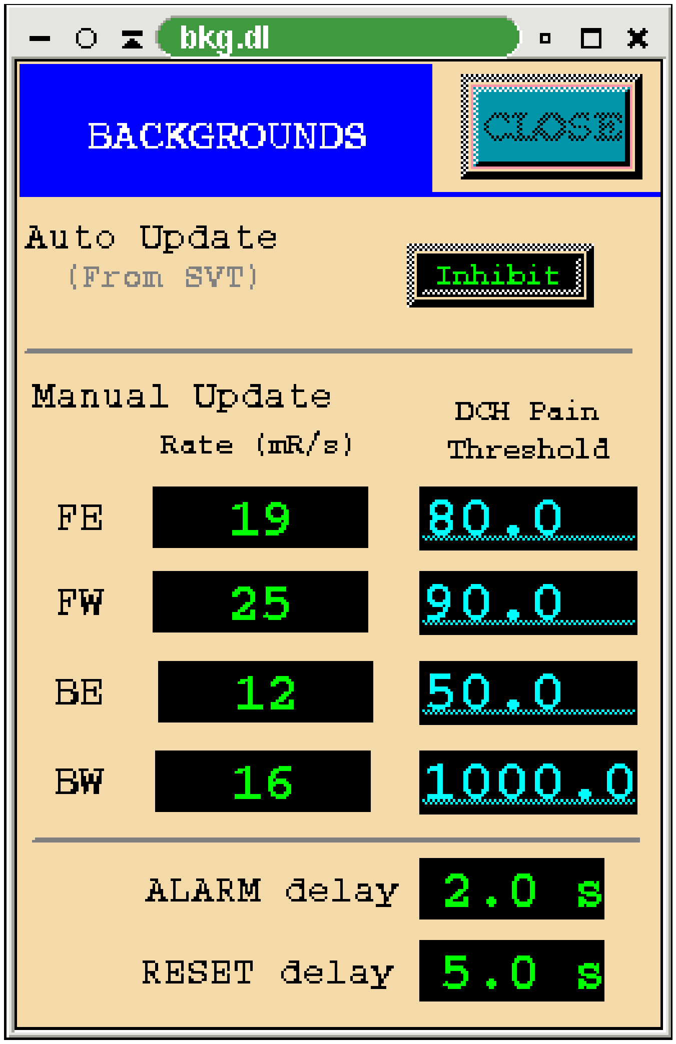
1. If auto trip recovery is off:
   go to local

2. If there is a HV spike trip:
   go to spike state

3. If not the above:
   set injectable(reset attempt 1)
   return to this state.

   House keeping

4. Wait until backgrounds are okay and then:
   start the three time out counters
   try injectable again (reset attempt 2)



return to this state

5. If backgrounds are high again:
   reset the 10s delay
   return to this state

   Success

6. If trip reset and backgrounds okay and 10s delay:
   go back to global

problem handling

7. If second time out:
   set off (reset attempt 3)
   return to this state

8. If third time out:
   set off again(reset attempt 4)
   go to local

The alarm handler causes a warning while this is going on. That warning triggers an entry in the dch section of the log book. If the trip is not reset by the 4th attempt, there is a major alarm and the HV is into local mode for the pilot to recover. The guidance in the alh provides this info as well.

The state keeps track of the number of times it is triggered, if this exceeds certain limits per fill/top off (3) or per run number (5), the auto trip recovery is disabled until a dch HV expert resets it. The alh has a major alarm for this occurrence. This triggers another elog entry and a page to babardch (and cbroan right now). The pilot may reset the alarm, recover the trip manually, and return the DCH to global control, but may not enable auto trip recovery. The alh has guidance for this situation and a link to the dch trip auto recovery panel.

There are several additional features to the auto recovery:

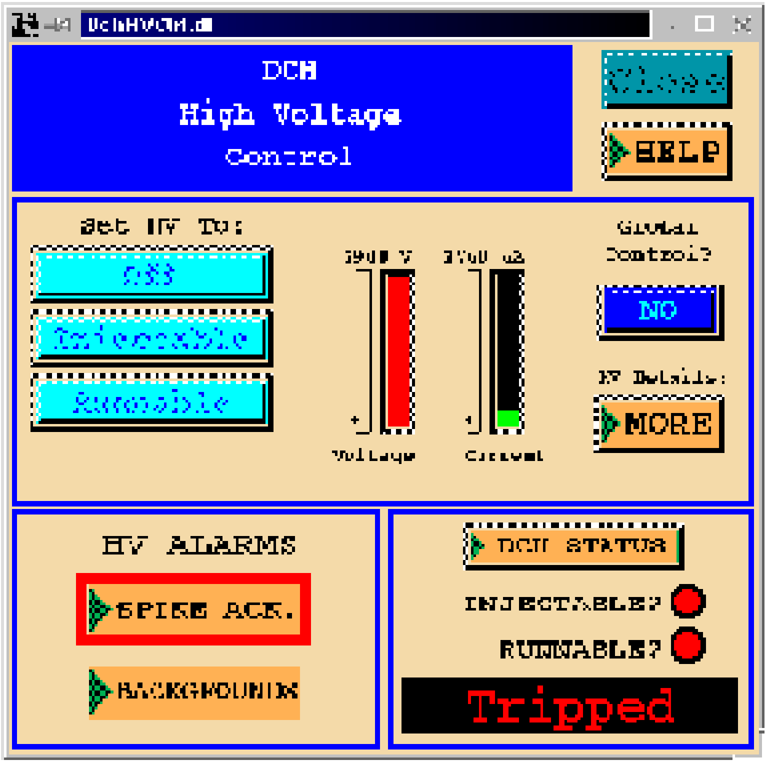
1. No modifications to other state machines were required.
2. Once reset, the normal global operations decide where HV should go.
3. There are other conditions checked, which I did not include for clarity. These include conditions such as skipping the 10s delay if the next state will be injectable and waiting for backgrounds before moving on to certain states.
4. DCH trip recovery status is displayed on bipinj.dl for the pilot.

Spike Monitor Trips

We have special software running in EPICS which watches for excess currents on individual channels, above the normal level but below the power supply trip threshold. If the same channel has two or more spikes in a short time, and no other channels show any problems, it is possible that one of the wires in the chamber is breaking down. The software will ramp the whole chamber OFF and will automatically page the DCH Operations Manager.

When this happens, the *[Spike Ack.]* button (left) will be outlined in red, and the chamber will automatically be taken out of Global Control. You must use the Spike Acknowledgement panel to reset the chamber for normal operation.

1. Bring up the *[Spike Ack.]* panel.


DCH
High Voltage
Control
HELP
Set HV To:
Global
Control?
NO
MORE
Voltage
HV ALARMS
SPIKE ACK.
DCH STATUS
INJECTABLE?
RUNNABLE?
Tripped


DCH
High Voltage Channel
Discharge Alarm
If you are sure,
Check the Discharge Times:

2. *[Acknowledge]* the alarm condition. You may have to *[Page DCH Expert]* as well, but sometimes not.
3. *[Close]* the panel when you're finished.
4. Return the chamber to "Global Control."
5. Record the trip and any special conditions in the logbook.

Recovering from a Power Outage

When the power to the Drift Chamber system is turned off, it must be restored in the correct order to ensure proper initialization and operations of the high voltage. All of the components are located in Electronics House Rack B620B-11. The steps are summarized here, and the locations of each module are described below.

1. Power on the Low Voltage module.
2. Disconnect the serial cable from the High Voltage CAEN module.
3. Power on the CAEN.
4. Re-connect the serial cable to the CAEN.
5. From a terminal, connect to the DCH-HV serial interface (`xyplex DCH-HV`) and then disconnect from it (`Ctrl-]` followed by `quit`).
6. Power on or reset the DCH-MON IOC.

If any of these steps fail, or if there are alarms or other indications of problems, please contact a DCH expert (Section 12.5).

The Low Voltage power supply module is the blue panel near the bottom of Rack B620B-11. The LV powers the front end electronics and all of the environmental sensors associated with the front end. After power is turned on, the LCD meters on the crate should read about 7.8 V and 210 A.

The CAEN High Voltage module is the large red box about five feet up the crate. It has a key control for power. None of the toggle switches should be changed from their normal positions (call a DCH expert, Section 12.5) if you're unsure.

The DCH-MON IOC is located in Rack B620B-10, at the far left of the crate containing the SIAM safety interlock modules. It's the one with the red front panel. It should have rebooted automatically when the rack power was restored (Section 26.4.5), but if not, the Reset button is clearly labeled on the front panel.

22.5.2 Environmental Monitoring

Information provided by Vincent Tisserand (Annecy) at
.../BFROOT/www/Detector/CentralTracker/controls/env/.

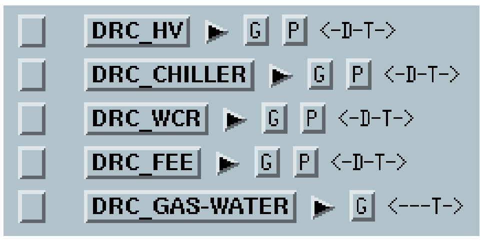
22.5.3 Gas System

Information provided by Vincent Tisserand (Annecy) at .../BFROOT/www/Detector/CentralTracker/controls/gas/.

22.5.4 Alarms and Interlocks

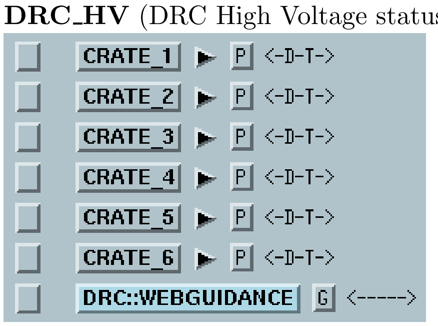
22.6 If there is a DRC EPICS alarm

The guidances provided in the DRC EPICS pannels are well-detailed: they usually describe the problem and normally provide solutions. Shifters should read them carefully before paging the DRC commissioner. Any feedback on the ALH guidances is welcome: please e-mail babardrc or send a message to the DIRC hypernews.



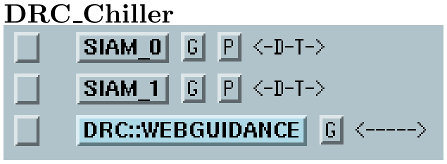
The DRC EPICS panel is divided into 6 sections:

- **DRC_HV** (DRC High Voltage status)



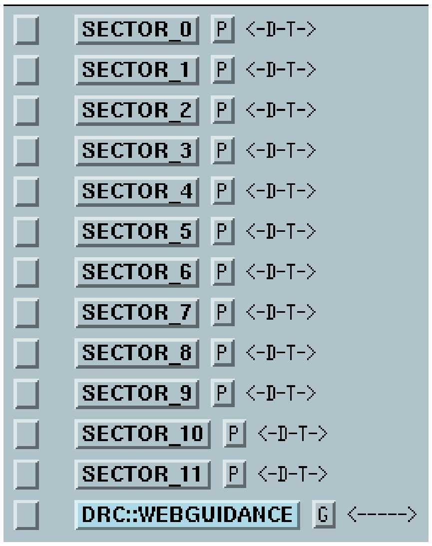
Each of the 6 DRC HV crates steers 2 sectors which each hosts 56 channels plugged on 4 boards (powering 16, 16, 16 and 8 HV channels respectively). Each channel is linked to 16 PMTs and needs its voltage to be nominal (called 'V0' in the DIRC; V1 = V0 - 300V is the injectable voltage) to work well.

- **DRC_Chiller**



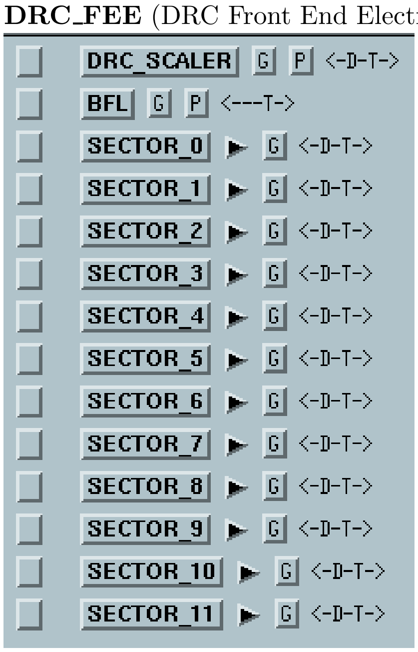
Like for other subsystems, the DRC chiller cools down the electronics: a chiller not working is a serious problem. If this happens, the pilot should page the DIRC commissioner immediately and have a look at the following instructions.

- **DRC_WCR** (DRC Wiener Crates)

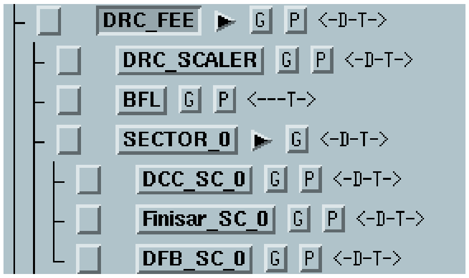


There is one crate per DRC sector whose behaviour is monitored by a large set of information: voltages, temperatures, fan speeds etc.

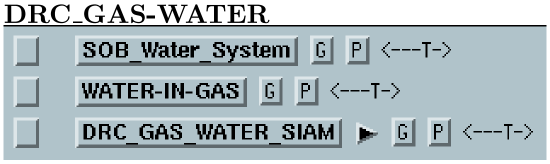
- **DRC_FEE** (DRC Front End Electronics)



Information displayed in this section comes from the other side of the chain linking WCRs and FEEs – e.g. the voltages read in the FEEs must be compatible with the values provided by the WCR sensors. The scalers are PMTs (one per sector) which are simply counting hits; there are very sensitive to background conditions. In addition, the Finisar EPICS items provide the status of the optical fiber link of each crate: any red value in this screen is likely to trigger some problem.



- **DRC_GAS-WATER**



  The DRC needs to keep the water in the SOB ultra-pure; the first panel (click on 'P' on the first line to see it) shows the water circulation system such as the key parameters monitoring its status. In addition, the DRC has also a complex survey system tracking any water leak which uses nitrogen; it is monitored by the two next alarms – see guidances ('G') and panels for details.

- **DRC_BACKGROUND**
  This panel displays monitoring variables computed on a fourth DRC IOC called drc-soft. As this software package is independent from the rest of the DIRC IOCs, having problems with it will not have any consequence on the data taking. During week day time, you can page the DIRC oncall expert; otherwise, just send an e-mail to babardrc.

Scaler DRC yellow or red alarms are usually due to high background condition and thus should disappear after a few seconds; on the other hand, if their number increases too much and if they tend to become persistent, the pilot should call MCC to ask the machine crew to tune the beams to reduce background.

DRC HV current alarms can also originate from high background; in this case, they disappear by themselves after a short while. If not, they may trigger a serious problem and pilots should react fast.

The latter statement is 100% valid for any alars coming from the water-gas system, the FEE or the WCR. These systems are *not* sensitive to background conditions.

22.7 there is an EMC Low Voltage alarm

Compared to the early days of Babar, the EMC has become very quiet in terms of spurious alarms. Nevertheless here is some guidance to help you sort out false alarms from real alarms that we should not ignore.

1. If only one channel is bad (i.e. a single current, voltage, or temperature) it is PROBABLY a readout problem. Look for other anomolies on the board reporting the problem. Are all the other currents, voltages, and temps OK? Does the data from the DAQ show anything wrong? If not, we must assume it is a false reading. Call the monitoring expert to change the alarm limits so it will not annoy shifters and will not cause them to miss a real alarm.

2. If there are other indications of bad behaviour, we must suspect a problem in the front-end electronics. The DAQ (and possibly monitoring) experts should be called.

3. If five consecutive boards look screwy, it is almost certainly a bad monitoring board. First try cycling the power to the monitoring boards (CAN0 for BB IOBs, CAN1 for BF IOBs, and CAN2 for EC IOBS and all TRBs). If that doesn't fix the problem, call the monitoring expert to come change the board.

4. If two or more quantities from the same IOB or TRB look bad, we have to suspect a bad IOB or TRB. Call the DAQ expert.

22.8 there is an IFR High Voltage Trip-Alarm

See section 22.8.4

22.8.1 IFR Help Page (HV-LV-CAN-FEE)

Here you can find some useful information about the Detector Control EPICS panels and about some typical alarm/problems in the Low Voltage, High Voltage, CAN-bus and FEE DAQ crate systems.

22.8.2 Power Outage Recovery Procedure

1. Low Voltage/Monitoring

   In the electronics house:

   - Go to the rack with the IFR switch panel (rack 04):
     - The AC line switch should also be switched on.
     - There is a panel with a lot of switches (I.F.R. Remote Supply Switch Chassis) designated as EC-LV-PS EC-LV-MON AC-DAQ B-LVMON B-LV-PS All these switches should be on. If they are not turn them on.

   In EPICS:

   - From the main IFR EPICS panel, select the FEE DAQ crate button. You will get a schematic picture of the detector with the position of all DAQ crates.
   - Select "Details" for any one of the crates. It will pop up a panel with specific information for that crate.

- In the Status Section, look at the “AC ON” item. Is it red? If yes, you need to switch the crate on:
  - push the “Controls” button
  - in the popped up panel, push ENABLE and AC ON; the AC ON should now be green.
  - do the same for all crates.

2. HIGH VOLTAGE

   In the electronics house:

   - Go to the rack with the IFR High voltage CAEN crates (rack-08, the HV crates are red). There are five such crates.
   - Is the key in each crate turned on. If not, turn it on.
   - Is the ENABLE button on each crate set to Enable (the small red light attached to it should be switched on). If not, enable it.

   In EPICS:

   - a) Is IFR HV on? To check it:
     - - Go to the IFR HV EPICS panel (High Voltage button from the main IFR panel)
     - - Select one of the IFR sectors (for instance “Barrel forward”)
     - - In the list of HV channels, look at the “Stat” column. It’s telling you whether that channel is off, on, or tripped. The actual high voltage value is in the “Vmon” column.

     In case it’s off, probably the Pilot will not be able to reset it in global mode; do the following:
   - go the IFR configuration panel in EPICS (from the main IFR panel, yellow button).
   - Set the IFR mode to LOCAL (bottom right button in IFR configuration panel)
   - Set the local mode to injectable
   - Once the HV is up to its injectable value, reset the IFR mode to GLOBAL.

   The Pilot should now be able to bring the IFR HV to injectable and runable as he usually does. If not call IFR expert.

22.8.3 IFR High Voltage white alarm

If for any reason an IFR HV channel is ramped down to voltages between 100 and 1000 Volts, it probably will become WHITE. This is due to the fact that IFR HV channels go to an INVALID status during the ramping down.
This events commonly happens when

- a channel trips and is not promptly recovered;

- an IFR channel is turned off.

You can use the CMLOG to check if the white alarms are correlated with one of these two operations:

- the white alarm entry has severity INVALID and value ILLEGAL
- if the channel tripped, the white alarm entry follows a red alarm entry on the same channel
- if the channel is turned off or ramped down, the white alarm entry usually follows another entry on the same channel with value RDOWN

22.8.4 IFR High Voltage Trip-Alarm

When an IFR HV channel trips it will generate:

- an alarm in the Alarm Handler;
- an alarm in the main IFR EPICS page (HV button will be RED);
- an entry in the CMLOG;
- the IFR will be RUNABLE until the number of tripped channels is less than 3.

An IFR HV trip not promptly recovered can give a WHITE ALARM. You can understand if the WHITE ALARM is due to a TRIP looking to the entries in the CMLOG (see section 22.8.3).

TRIPPED channels must be recovered promptly, BEFORE the channel goes to 0 Volts. There are no reasons to wait: if the DAQ is running, the longer you wait, the larger is the amount of data with several chambers off. If you wait you will have a WHITE ALARM

What you can do:

- Open the IFR HV EPICS panel. It consists of 6 subsystems.
- When a subsystem button has a red frame it contains at least one tripped channel.
- Open the RED subsystem EPICS panel.
- The status message (STAT column) of the tripped channel will be TRIP (in red).
- The status could also be WHITE with the value INVALID (if the trip was not promptly recovered, see section 22.8.3)
- Open the corresponding DETAIL panel using the detail button on the right.
- Check that the TripTime (TripR) is 50 sec. If not write in the TripW box 50 (push return) and check that after a few seconds the TripR box will have 50.
- Power cycle only this HV channel using the ON/OFF button in the on/off column.

- Make an entry in the e-logbook describing the channel and the crate which tripped.
- If the channel will trip again:
  - Switch OFF that channel using the on/off button;
  - Open the MASK panel from the HV panel and mask the tripped channel;
  - Make an entry in the e-logbook describing what you did;
  - Call the IFR expert but remember that he cannot do anything without an access.

Please if a trip occurs try to undestand which channel really tripped BEFORE TURNING ON/OFF anything.

- The tripped channel has the ON/OFF Button still ON.
- Please, do not turn on a MASKED channel
- A MASKED channel is not included in the IFR state machine: it will not ramp up and down. Masked channels must allways be OFF.
- Probably in normal beam conditions, if you turn on a MASKED channel, it will trip.

22.9 there are disconnected EPICS channels

22.9.1 EPICS architecture

To locate the cause and determine the significance of disconnected EPICS channels, it is necessary to understand the basics of EPICS and of its implementation in BaBar. At the heart of EPICS is the *channel access* protocol. Channel Access provides a mechanism for the communication of monitoring and control information among a set of Single Board Computers (*Input Output Controllers or IOCs*) and client processes running on UNIX hosts. It does this without using a central directory or registry by using the UDP broadcast and multicast mechanisms. An IOC that wants the value of channel will broadcast the name of the channel. The IOC which can serve that channel will respond and a channel access connection will be established. For obvious reasons, the extent of the broadcast must be limited. In our case, it is limited to an IR2 Ethernet subnet which contains the IOCs and a small number of UNIX nodes (bbr-con01, bbr-con02, bfo-srv01, and bfo-srv04).

Many clients run on nodes not in this privileged subnet. bbr-dev and other bbr-con and bbr-srv are on another IR2 subnet. bfo-srv01 is on both of these subnets. A process called the *gateway* runs on this machine and relays requests from one subnet to the other. The gateway appears as a single client to the privileged sub-net, thus reducing the load on the IOCs.

The PEP world has two sources of information. PEP has its own EPICS subnet. One IOC on this subnet is the Bunch Injection Controller (BIC, aka PEP-II) which talks to one BaBar IOC (cen-bip) via a private router between these two machines. Channels served by the BIC begin with HB60:, LB60:, or PB60:.

PEP also has *alpha* computers which run the *SLC Control Program (SCP)*. This program does most of the instrumentation and control for the LINAC and PEP. SCP gathers data via the SLCnet, which connects a set of IRMX Intel based single board computers called *micros*. Of particular interest to us are the micros PR02 and PR00 which collect information near IR2. Some of this information is made available to BaBar via a *Portable Channel Access Server (PCAS)* which runs on the alphas. A PCAS runs the Channel access protocol. This PCAS is visible to a BaBar IOC (cen-bip) via a router. This PCAS serves channels beginning with ACC:.

The final sources of channel access information are three PCAS processes running on the BaBar UNIX machines: bbr-con00, bbr-con06, and bbr-farm06 (aka bbr-odf06). These serve channels beginning LM:, L3T:, and FCT: respectively. Since these machines are not on the privileged subnet, they communicate with nodes on the privileged subnet via the a secondary gateway: bip2fct.

22.9.2 Diagnosing Gateway Problems

If all machines in IR2 *EXCEPT* bbr-con01 and bbr-con02 (the pilot's machines) show either white, disconnected channels or frozen, unchanging values, then chances are the PROD gateway needs restarting.

From the main epics panel, odc_main.dl, click on the button *Gateways* in the BaBar/PEPII CommLink area. On the "PROD" side of the panel, click on "restart" button to kill and restart the PROD gateway processes.

If, on the other hand, only the FCT and/or BKG buttons on odc_main.dl are framed by a white box (instead of green), then chances are the BIP2FCT gateway needs restarting.

From the main epics panel, odc_main.dl, click on the button *Gateways* in the BaBar/PEPII CommLink area. On the "PROD" bip2fct side of the panel, click on "restart" button to kill and restart the PROD gateway processes.

Each time you restart a gateway, you must wait until the number of channels currently requested and cached stabilizes before you can expect everything to be connected again. Use the gateway.dl panel to watch this.

If you restart a gateway and things still aren't correct, page the DAQ operations manager to report the problem. Note: data-taking does not depend on the gateway processes running, so you should be able to continue running.

22.9.3 EPICS clients

There are several common EPICS client types. The ones routinely used by BaBar are dm (the EPICS displays), alh (the alarm handler), striptool (the history display), the archiver (records channel values into the ambient database). Programs used in conjunction with these EPICS programs are Ambient Explorer (looks at ambient database), and cmlog (looks at the alarm history).

22.9.4 invalid, error, disconnected

An EPICS channel has several fields. Relevant to this discussion are the *channel name*, the *alarm severity*, the *status*, and the *value*. Current values of these channels may be examined in several ways. In a *dm* display, middle click on the displayed value and then click on examine in the pop-up window. This is not very revealing for channels served by a PCAS, since these do not have normal EPICS db entry. The *alh* displays the alarm severity. *Cmlog* shows past values these fields at the time of changes of the alarm severity. Probe is an application which peeks at EPICS channels.

The alarm severity can take on the values NO_ALARM, MINOR, MAJOR, INVALID. MINOR and MAJOR indicate a value which reveals some problem with the monitored equipment or they indicate a problem in the inputs used to calculate the value. In the former case the status will be HIHI, HIGH, LOW, LOLO, or STATE. In the latter case the status will be LINK. INVALID means that the channel could not be evaluated for some reason. The alarm handler displays ERROR when it cannot communicate with the device serving the channel. Such channels will be described as *disconnected* when viewed in dm. We informally call INVALID and ERROR channels *disconnected* because the most common cause is a communication failure somewhere along the data path. Locating that somewhere is point of this section.

error

Error means that the alarm handler could not find an IOC to serve this channel. These channels will be described as disconnected if viewed in dm. If the alh instance is running on a non-privileged subnet, the gateway may have a problem. In this case nearly all channels will be in error. If the gateway process has died, a cron job will restart it in a few minutes.

More likely the IOC or PCAS is not responding. In this case, all the channels served by that IOC or PCAS will be in error. Examine the channel names to determine which one is not responding. Check that the IOC or PCAS is not responding on bbr-con01. Sometimes an IOC runs out of connections and will not talk to a new client. Examine the status of an unresponsive IOC on the odc_main→cen→IOC→IOC panel. If these are all invalid as well, the IOC is probably hung and will need to be rebooted. See the IOC reboot instructions. If the channel is being reported properly on clients which have been running for some time, but not on newly launched clients, then it is the new connection problem and the IOC will need to be rebooted.

invalid

Determining the cause of *invalid* channels is more difficult. Again the key diagnostic is the pattern of affected channels.

If all channels beginning with ACC: are invalid, then the PCAS running on the PEP alphas needs to be restarted. Complicating this diagnosis is that many channels on BaBar IOCs have channels from this PCAS as inputs and will be invalid as well. Their status will be LINK. Some channel names in this category are those beginning CEN:ACC:, CEN:DCH:PIN:, CEN:EMC:PIN:, and some CEN:PEP:. If the PCAS is OK, there may be a network problem. In any case this is a problem for MCC.

If all channels beginning LB60:, HB60:, PB60: and those derived from them (CEN:LB60:, CEN:HB60:, CEN:PB60:, some CEN:PEP:, CEN:PEP-2:, some CEN:BIP, etc.), then there is a problem with the BIC IOC. Contact MCC.

Now we are left with sets of invalid channels more localized than an IOC or a PCAS. There is a variety of causes which have no logical organization, so I will describe them in no particular order.

- One or few closely related channels are briefly invalid and then recover: Sometimes a piece of hardware does not respond when addressed. The next time it works fine. This will cause all data derived from this read to be invalid for one scan period. There is nothing to be done but grumble and make note of affected channels. The most common culprits are GMBs and CAEN supplies. More rarely Wiener crates will do this.
- A large set of information from front end electronics is invalid: The power to those electronic components is turned off.
- A set of information from a particular one or small group of monitoring devices is invalid. Power is off to the monitoring device or there is a bad connection. Most commonly this will be a set of GMBs.
- Other similar patterns. One just has to deduce the common element of the invalid channels. At present there is no simple way to trace the channel to channel connections to make this easy. Channel inputs may only be done by grepping for the channel name (or part of the name when arguments are used) in the $DAPPDIR/iocname/db/ directories and then reading the record entry in the *.db and *.tmpl files.

22.9.5 A special case of invalid channels

Sometimes IOCs get into a state where they are unable to make new connections. Thus a channel may appear OK on a display which has been up for some time, but be disconnected on new displays. The problem can occur in both directions, that is an IOC may not be able to connect to a channel on another IOC that is available to other clients, or may be unable to serve a channel to new clients.

This happens most often and most dramatically on CEN-BIP. Once CEN-BIP is in this condition, if the BIC is rebooted, communication with PEP will be lost. The consequence is that many PEP related channels will be invalid to all clients and that PEP will not be able to inject.

The general cure for this disease is to reboot the offending IOC. See the chapter on rebooting IOCs. In the case of CEN-BIP, nothing may lost be rebooting it, if it is in this state, since its primary function is communication with the BIC.

Chapter 23

UNIX Problems

In case of a problem related to the general computing infrastructure call the SCS Help desk at x4357 (this is H.E.L.P) and select the appropriate option. If the problem is critical, dial 1, You should receive some feed-back within 10 minutes. If you receive nothing within 10 minutes, you should page directly the number given by the voice mail.

Other contacts are given in section 12.12.

Chapter 24

an Online Software Error Message

Descriptions of some software errors and their resolution are described in $BF-ROOT/www/Detector/Operations/shifts/DAQDoc/BaBarDAQTroubleshooting.html.

Chapter 25

when there is a Service Interruption

From time to time the Pilot will notified of a interruption of some utility service, such as electrical power (regular or "Uninterruptable"), chilled water, site air, or some service needed by the preceding, such as tower water. The notification may be of an already occurring unscheduled outage, of the need for an emergency outage, or that a scheduled outage is now going to happen.

In the first case, Cryo should be notified if relevant. Cryo uses standard and UPS power, chilled water, and site air. Then the appropriate remedial action, as described below, should be taken. Remember that BaBar equipment is self-protecting. In the case of service interruption, the equipment will automatically put itself into a safe state. Alarms will go off to inform you that this has been done.

In the second case, the urgency should be ascertained, and working with cryo and any other affected parties, the outage scheduled. At the appropriate time, the experiment should be prepared for the outage as described below.

If the particular outage is not described below, consult with the run coordinator.

25.1 Power Outage

The preparation for, or response to, a power outage depends on the circuits involved. A few of the more likely and, or significant cases will be described here.

The most obvious is a general unscheduled power outage. This situation is described in chapter 26, as is a loss of power in the electronics house. Loss of power on the utility pad may result in the loss of other services such as chilled water. Respond accordingly.

If an EH power outage is scheduled, then before the outage, LV and HV power supplies should be turned off, and the workstations shut down with the front panel button.

25.2 Chilled Water

There is a large chilled water plant (four large chillers) on the IR2 utility pad next to the ring road between building 625 and the gas shack. This water is used for air conditioning, EH rack cooling (via a heat exchanger on top of the EH), and as the heat sink for several of our system chillers and heat exchangers. This chiller plant needs tower water and power to run. Outages may be needed for cooling tower work, electrical work, chilled water plumbing work, or chiller maintenance.

In the event of a loss of IR2 chilled water, you have about ten minutes to turn things off and avoid a power trip. After an unscheduled interruption, or before a scheduled one, the following steps should be taken:

1. Contact Cryo.
2. Turn off the EMC diode supplies (EPICS).
3. Turn off the EMC LV supplies (racks 1-4).
4. Turn off the DCH HV (EPICS).
5. Turn off the DCH LV supply (rack 10).
6. Turn off the DRC HV (EPICS).
7. Turn off the DRC FEE crates (EPICS).
8. Turn off the SVT power supplies (EPICS).
9. Turn off all EH VME crates except CEN:MON (top rack 9) and CEN:BIP (rack 17).
10. Open both the front and back doors of EH racks 13-16 and 35-37. These racks have the farm machines and the switches.
11. Put two floor fans in the computing alcove (next to the control) room to direct hot air out.

After the restoration of chilled water, the process should be reversed. Be sure to keep an eye on the water temperature to be sure the water chiller plant is functioning correctly. The EH heat exchanger panel (odc_main→CEN→EH cooling Details→heat exchanger) monitors the chilled water. There are also gauges on top of the EH and in the back of each rack pair.

25.3 Site Compressed Air

The only BaBar equipment that uses site air are the SVT and the DRC SOB water dump valve. The SVT will automatically go into a safe state if site air is lost. It also has a backup cylinder of compressed air. Contact the SVT expert in case of a site air problem. The DRC has a ballast tank that should last more than 12 hours. The DRC people should be notified of site air outages. Cryo also uses site air, so they need to be kept informed about any site air problems. The IFR and DCH gas systems both use site air. They have backup compressed air tanks.

25.4 Dry Nitrogen

Many BaBar systems use boil-off nitrogen to keep clean and dry. They are the DCH, the DRC, and the EMC. For scheduled outages, nitrogen will be supplied from bottles. In fact, most systems have back-up bottles already connected. These will take over without intervention and should last several hours. In the case of unscheduled outages, contact the cryo-techs.

The DRC system does not have an automatic backup system in place. A backup needs to be established within 12 hours. Contact the DRC people in case of any loss of N2.

25.5 Tower Water

The ultimate heat sinks at SLAC are the cooling towers. Water from these towers is used as the heat sink for the IR2 chilled water plant. Hence, a tower water outage is tantamount to a chilled water outage.

25.6 Uninterruptable Power

An interruption of UPS sounds like an oxymoron. It is true that most maintenance of the UPS system can be done by transferring the load to standard power without interruption. If there is a general outage, the time remaining before UPS failure will be displayed on the UPS front panel. The UPS is located in the northeast corner of the Hall. In the case of UPS failure, see section 25.1. If UPS power needs to be down for maintenance, or more likely, modification, the electricians will bypass the shunt trip system so as to minimize the disruption. In this case the CEN:ILK, CEN:MON, CEN:BIP, and DRC SOB water monitoring crates will lose power. If the outage is going to last a significant amount of time, their power cords can be moved to standard power outlets (after the shunt trip system is bypassed).

25.7 Phone System

If there is a phone malfunction, first be sure that it is not due to the phone itself (try another instrument on the line). For dual line (e.g., the console phones), be sure that none of the conference buttons is pushed. Once you are convinced it is a phone system problem, submit a report via the phone remedy system.

If the central phone switch is down, use the direct outside line *854-3120*. This phone is in the corner of the console.

Chapter 26

Power outages

26.1 What is covered in this chapter.

There are four scenarios which can lead to a loss of power. SLAC may be asked to reduce power consumption (brown-out) or may be cut off temporarily (blackout, very unlikely). These actions should come with forewarning (although not necessarily much). Alternatively some accident, emergency, or alarm may cut the power to some or all of IR-2 (and beyond). In the former case there may be action which the shifters can take which will reduce the chance of damage to the detector. In the latter there are actions which the shifters can take to improve the chances of bringing the detector back safely.

26.2 Scheduled Brown-out

"Brown-out" is a SLAC misnomer for a power company requirement for reduced electrical power consumption. It usually means that accelerator operations will cease. There are no power restrictions for BaBar proper. It is expected that the shifter will receive notification of a brown-out from the run-coordinator, but if the shift crew is contacted and informed that a brown-out has been announced, they should
`telalert -i babarrunc -m ''Have been informed of brown-out at hh:dd''`.
Nothing special needs to be done to the detector, just maintain it in readiness for when beam returns. Notify any systems that have posted a need for no-beam time on the downtime requests white-board.

26.3 Scheduled Blackout

A blackout is the total removal of power form the site. We do not anticipate any scheduled blackouts. Blackout preparation instructions may be found in appendix E.

26.4 Power Failure

By definition there is no warning of a power failure. The failure may be partial or complete within IR-2 and may or may not affect the rest of SLAC. The response of the shift crew should be tailored to the circumstances. One of the pilot consoles (bbr-con01) is on UPS, so, if the outage is local to IR2, you may use it to contact the Run Coordinators:
`telalert -i babarrunc -m ''The lights have gone out on BaBar''`.
The following is organized into sections according affected areas, and then gives instructions for during, and recovering from, the outage by system.

26.4.1 Communication when the central phone switch fails

Sometimes when there is a site-wide power failure, the central phone switch will go down. In this case you can communicate with outside world via the direct outside line *854-3120*. This phone is located in the corner of the console.

26.4.2 Uninterruptible Power Supply

Some installations in the PEP IR2 Hall are protected by a UPS from loss of electrical power. The estimated life of the UPS batteries is about six hours. Nothing drastic will happen when the batteries die. The following systems are connected to this system:

1. Some cryogenics controls
2. Fire Detection and Alarm system
3. Alarm Annunciator
4. CEN-ILK, CEN-MON, and CEN-BIP crates.
5. The rack water valve controllers.
6. The data switches in the EH
7. The File Server
8. SOB water monitoring crates

Some devices have their own batteries:

1. Emergency lights
2. SOB water dump control
3. Fire protection system

The phone system has its own UPS elsewhere.

26.4.3 Power failure in IR-2

1. Call all the system on-call people. This can take a while, so this should be left to the navigator while the pilot proceeds with the rest of the list.
2. The magnet system is stable for >8 hours, so don't panic. Nothing bad will happen immediately.
3. Magnet system: cryo is probably already on the way, but call them anyway.
4. Log the power failure in the log book.
5. Open the front and back doors of racks 13, 14, 15, 16 and 17 in the EH and racks 35, 36 and 37 on the EH roof. Turn off all CAEN supplies in EH racks 5, 6, and 8.
6. The SVT needs three procedures to be completed if power in IR-2 has been lost and the SVT monitoring records have gone white. THESE MUST OCCUR BEFORE ATTEMPTING TO BRING POWER BACK TO IR-2. These procedures are listed below and SHOULD BE DONE IN THE ORDER LISTED.
   (a) Page the SVT expert on call. The immediately go and:
   (b) Turn off all SVT power supplies. On top of the electronics house roof, in 4 racks (#29, #30, #31 , #32), there are 12 red CAEN crates (3 crates per rack). The front panel of each crate has a key-switch in the lower left-hand corner. This key needs to be rotated clockwise to the off position. In the off position, the key will be vertical, and all lights on the front panel should turn off, as should the LCD display . Be sure to turn off all 12 supplies - the order does not matter. Upon completing this step, immediately go and:
   (c) Shut-down the SVT chillers. On top of the electronics house roof, in rack #34, there are 2 blue panels labelled "SVT Chiller/Purge System". The right hand side of these panels have red buttons labelled "Emergency Shutdown". Press this button on BOTH panels. There will be no audible or visible response, but you will have cut the power to the water chillers. (Following the 2000-2001 shut down, please corner an SVT expert to update this procedure, as different instructions will be necessary)
7. Call DCH gas system expert (Pager 377-9893, or listed in DCH experts list (section 12.5). The DCH bulkheads are flushed by N2 gas to avoid creating a hazardous gas mixture (Isobutane plus Oxygen). If the power failure includes the gas mixing shack IR2, boil-off nitrogen N2 gas will not be used, and a single N2 bottle, located in BaBar gas hut, provides the gas to the bulkheads. This bottle will last about 3.5 hours, and the DCH gas system expert will have to come before it runs out. BaBar shift people should not work on the DCH gas system unless following the instructions of the DCH gas system expert.
8. The air conditioning will be off everywhere, but electronics connected to the UPS system will still be on. This may cause overheating. The computing alcove next to the control room is an area of concern. Plug a floor fan into a UPS outlet and direct its exhaust out the door.

9. If the EMC fluorinert chillers are left without power for more than half an hour, fluorinert back-flow may cause the reservoir to overflow. If the power does not come back within ten minutes, and there is either no good estimate of when it will return, or that estimate is greater than twenty minutes, contact the owners of the chillers. Follow their instructions on closing the manual valves. If you can't contact any of these experts, then follow the instructions in the red folder on the chillers.

10. If the power outage lasts more than an hour or is estimated to last more than two, then the load on the UPS should be reduced. Contact the online computing infrastructure people for directions on which devices to turn off.

11. Wait for the power to come back. You can amuse yourself by trying to localize the source of the failure.

12. If the UPS power runs out, you may need to manually dump the SOB water. Check with the DRC expert on call.

26.4.4 What to Do When the IR2 Hall Power comes back

Following a power outage, care must be taken to switch things back on in the correct order to avoid catastrophic damage. If the power outage was unexpected there may be 'false starts' with the power returning briefly before failing again. These should be ridden out with the detector shut down. It is not important to move fast, but to do the things in the right sequence.

1. Cryo: if cryo experts have left in the meantime, they are probably already on their way back.

2. Understand all alarms. Fix the cause if possible. The BaBar systems are your responsibility. Cryo should deal with the cryo alarms. Chapter 21 describes the source of the alarms. These alarms are there for a purpose. Do not treat them lightly. If you don't understand them, call an expert.

3. If the fluorinert chillers have had their manual valves closed, reopen them and restart the chillers. Follow the instructions in the red folders.

4. At this point, it is probably useful to split up, one person to bring up the Electronics House, another the Control Room.

5. Electronics House:

   (a) Ensure that the EH heat exchanger system is working.

      - Go to the top of the EH and locate the large heat exchanger on the middle East region. It consists of two large pumps, large plumbing, two heat exchangers proper, and controls. The pumps will be off, Use the large motor control buttons to turn them both on.

- Check the pressure gauges to be sure that there is more than a 15 psi pressure drop (supply-return) in both the chilled water and rack water circuits. Check that the chilled water supply temperature is 13°C or less. If so, the rack water supply temperature should soon go below 18°C. Problems with the chilled water should be reported to the HVAC people (see section 12.14). These technicians are not on site during off hours. If the power outage was widespread, they are probably already on their way, but it may be a while until they come to IR-2. The tower water cooling system must be turned on manually before the IR-2 chillers will come on. If the power failure was local to IR-2 and the chillers did not come up by themselves, the HVAC folks will need to be called. Contact MCC during off hours. Lack of chilled water will also affect the air conditioning in building 621. Place a couple of large floor fans in the computing alcove to direct hot air out into the control room area.
- If EPICS is running on bbr-con01 (it should be unless there is a problem with the UPS), check the status of the EH heat exchanger (odc-main→CEN→Cooling status details→Heat Exchanger).
  - If the above conditions are met, the rack water temperature should be OK. If not check that the rack water temperature controller (on the north side of the heat exchanger assembly) is running. If it appears to be without power, check that the GFI outlet into which it is plugged, is reset. If there are still temperature problems, call a central system expert.

(b) If the EH power is now on, you may proceed to turning the individual crates back on. Begin with all the 6U VME crates. Once these are on, you should be able to clear the alarms.

(c) If one or more zones in the EH are without power, go through the procedure for loss of power in the Electronics House (Section 26.4.5).

(d) Recheck the EH heat exchanger system again after the EH power has been restored.

(e) Check the alarm panel in the rack 6. Any red channels on the Alarm panel should be addressed. In particular the Electronics House alarm should be green. If not, try to reset the SIAMs in cen-ilk (rack 9 or via EPICS). If the EH alarm cannot be cleared, go back to the beginning of this section and try again. If that fails, call a central system expert.

(f) Close the front and back doors of all the EH racks, both inside and on the roof.

6. Control Room and Gas Shack:

(a) Annunciator panel alarms will not be meaningful until the source VME crates have been turned back on. Your partner is taking care of the crates in the EH. The cryo-techs will handle the crate in the cryo control room. (Remind them if they don't.) That leaves two crates in the gas shack for you to turn on. One is in the gas shack rack near the door. You can reach in past the locked door and switch it on by hand if EPICS is not yet running. The other crate is the DCH control rack.

(b) Address any alarms on the annunciator panel which are not due to faults in the EH. These will be mostly due to chillers and gas mixing systems. See the appropriate part of chapter 21 for instructions on clearing these alarms.

(c) Check that the building 621 air conditioning is operational. This can be done by some combination of the following:

   i. Place your hand over the control room ceiling outlet ducts and feel for cold air.
   ii. Use EPICS to check the control room temperature for a reasonable value ($<$ 25 degrees C).
   iii. If uncertainty persists, call the HVAC group.

(d) Have the magnet turned on if it should be on. This is done by the combined efforts of the cryo-crew and MCC.

(e) Turn back on any devices which were turned off to unload the UPS.

(f) You should now be able to clear all remaining faults if your partner has finished in the Electronics House.

(g) If the UPS power in zone 1 was off, the xyplex serial port servers may be keeping the IOC's from booting. This can be corrected by connecting to the serial ports with the `xyplex -f portname` command. See section 17.1. As soon as the IOC begins booting you can disconnect. Begin with CEN:BIP and CEN:MON. You should then be able to use EPICS to see which others need booting. Check the display MAIN:CEN:Detector Control Crates. If the bar on the left side of each crate is not green, the crate may need booting.

7. Hall

   (a) Restart the Hall ceiling exhaust fans. The control panels are on the north wall of the Hall, just East and below the platform in front of the door to the control room. Press the buttons marked "FAST." The red lights marked "FAST" should come on. Check the fan by observing the shutters on the fan in the ceiling above the EH.

   (b) Restart the power supply alcove (building 624) exhaust fan. The control panel is located on the roof of building 624. Go up the stairs at south side of the lower parking lot. At the first landing, turn right and proceed along the edge of the retaining wall to the roof. Look to your left and you will see the control panel. Press the "start" button.

8. SVT recovery

   Upon receiving notice of power-on page the SVT Commissioner at 849-9407 and they will come to IR-2 and restart the SVT. The following steps will be followed

   (a) Switch on the SVT monitoring board (back of B620B-33 rack).

(b) Switch on the power on the two VME Wiener crates which host the three SVT IOCs in the rack next to the CAEN power supplies.

(c) Reset the chiller by turning clockwise the two big red buttons in the chiller reset crate on the roof of Electronics Hut.

(d) Manually re-inhibit the non-connected (NC) channels on the bank of SIAMs in order to un-KILL the CAEN power supplies interlock.

(e) Unplug the CAENnet from the red V288 modules in the svt-lv VME crate. Do NOT turn on the PSs with the CAENnet plugged in the IOC.

(f) Key ON the twelve CAEN power supply crates (switch key counter-clockwise). To see if they re-booted cleanly, press the rightmost menu key under the crate display several times to see the screen scroll through standard options.

(g) Plug the CAENnet back into the V288 module in the svt-lv VME crate.

(h) Reboot the three SVT IOCs either by the front panel or from a xyplex terminal. Do svt-ilk first, then svt-lv and finally svt-mon.

(i) Now you should be in the COOLING_OFF state. If the HDIS summary panels show white, one of the CANbusses probably failed to restore correctly. You will need to power-cycle HTEMPs on the FE, FW, BE, BW CANbus (as appropriate) by using the panel on the back of Rack 33.

(j) Assuming the State Machine has been restored (you may have to re-boot svt-mon again), go to Cooling ON (if necessary reset manually interlocks inhibit).

(k) From the State Machine, go to HDI on.

(l) From the State Machine, go to ALL on.

(m) Reboot SVT ROMs.

(n) Take an SVT calibration.

(o) Put the SVT in GLOBAL mode (States → State Machine → Controls/Diagnostics → GLOBAL)

(p) Put the SVT in AUTOMATIC control (States → Run/Inj Controls)

9. DCH recovery

It is important to do things in the correct order. Don't hesitate to page the DCH operations manager at 846-0981, and the DCH Gas system expert **must** be called at 377-9893.

(a) Clear the Gas Shack Alarm and ask the DCH Gas System Expert to restart the Gas System. This is part of the gas system restarting procedure to restart and check the status of the DCH_GAS IOC. Make sure that the DCH_GAS IOC has also been restarted and the associated VME crate has been switched back ON (just check with the expert). For the gas system in the gas shack nobody else can do it without DCH Gas/Operation Expert prior approval. This is just as for a normal Gas System alarm, the expert has the procedure to follow when restarting the system.

(b) Check that the DCH Water Chiller is restarted (the chiller is in the IR-2 assembly hall and has instructions written on it).

In the Electronics Hut

(a) **LV Module :** Bottom of rack B620B-11, Low voltage supply (Blue BOX). Check if it is powered and read 8V and 220A.

(b) **HV Module :** Top of rack B620B-11, High voltage supply (CAEN CRATE). Check if it is powered and has the green 'check passed' LED on. In case of problems or hesitations please touch nothing and wait for the expert.

(c) **Slow Control :** Rack B620B-10, Slow control (VME CRATE). Check if it is powered. Reboot the IOC once again (push rest button) so that it will start communicating with the HV supply.

(d) **DAQ and ODF :** Top of Rack B620B-27 : DAQ (ROMs GLinks CRATE). Check if it is powered and all the ROMS have the green 'i960' LEDs on. You make have to wait until the network switch and file server comes back on.

(e) **EPICS Console Panels :** Check if it is back to life and that there is nothing white, yellow or red.

- If the DCH panels are all white, the IOC did not boot, page the expert.
- Sometimes the VSAMs for the DCH-MON and DCH-GAS IOCs stay stuck, just perform another reboot in this case (push the reset buttons on the VME boards, or better still log in through Xyplex to dch-mon or dch-gas 'xyplex -f dch-mon' or 'xyplex -f dch-gas' then type CTRL-X to reboot and CTRL-] to escape).
- Go through the panels to find anything bad. You may have to wait for the other part of the system, e.g. the Fast Control Master crate, to recover before you get everything working.
- If you have yellow and red colors, except for the HV, which will be ramped down, there are alarms (warnings) to be solved and cleaned (to be itemized and reported) with the help of the DCH Operations Manager.
- If the EPICS panels show white (disconnected) for the forward endplate monitors (temperature, humidity, etc.), the shift leader should press the power-reset button on our forward-endplate GMB, located in the DCH power-supply rack.

At this point the DCH should be ready for global calibration.

10. DRC recovery
Upon receiving notice of power-on page the DIRC Commissioner at pager 846-0545 and they will power up the DIRC.

11. EMC recovery
Upon receiving notice of power-on page the EMC shifter using the number on the white-board. The following actions must be performed in the order listed here.

(a) Check if the **diode bias power supply** (red CAEN crate in E-Hut rack B6203-03) has turned on properly. Two yellow lights should be on and the LCD display should show ‘CAEN sy527’. If not, turn the key to ‘off’ and back to ‘on’. The crate takes a few minutes to boot.

(b) Switch on the two VME crates housing the **monitoring (EMC-MON)** and **interlock (EMC-ILK) IOCs** in the top of rack B2603-04. It may take the IOCs a few minutes to reboot. They boot off bbr-srv01 so this machine needs to be online first. Check if the **monitoring (EMC-MON)** and **interlock (EMC-ILK) IOCs** are working properly : can you bring up the EMC EPICS panel and is everything non-white? If not get the EMC shifter on the case, that is what they are for.

(c) From the EMC EPICS panel, click on ‘Bias Voltage’ and push the green button on the bottom of the panel that appears. You should see all ten channels ramp up. After a minute all the channels should have settled into their green values for ‘Vmon’ and ‘Imon’.

(d) Convince yourself that all EMC chillers are running properly (fluorinert and water chiller). They should have temperatures and flow-rate as posted next to the LED displays on the chillers. The fluorinert chillers should each have four green LEDs lit. **For any problems with the EMC chillers contact an expert**:

   i. EMC commissioner (see white-board)
   ii. Eric Doyle (x2861)
   iii. Hall Manager (424-7193)

(e) Turn on the front-end electronics: **In the Electronics Hut, switch on the 10 crates housing the 100 LV power supplies located in racks B2603-01 -02 and -03.** The switch is located on the lower left part of the crate. The switch on the power supplies by pressing the only button on each front panel. All power supplies should have their green LED lit.

(f) The EMC EPICS panel should have no alarms left.

12. Solenoid revovery
    Upon receiving notice of power-on page the cryotech at 846-9907.

13. IFR recovery
    Upon receiving notice of power-on page the IFR Commissioner at 849-9117.

14. TRG recovery
    The TRG DCZ crates have special power-up sequence due to interuptions in timing of the DCZ clock. They should be powered back in this order:

    (a) Master crates and DCZ ROMS (rack B620B-26 bottom crate)

    (b) TSF crates (rack B620B-25 bottom and top crates)

    (c) BLT/ZPD crate (rack B620B-25 middle crate)

Or see the web page for DCZ power-up sequence. If in doubt, page the TRG Commissioner at 849-9647.

15. Computing recovery
 Page the on-call computing expert using the number on the board or, preferably, `telalert -i name -m 'Power restored'`.

16. Ready for Data
 Do all calibrations and a test run in anticipation of PEP II beams hours later. Investigate any failures or problems thoroughly. If things have been restarted in the wrong order problems will occur.

26.4.5 What to do when the POWER in the ELECTRONICS HOUSE GOES OFF

Diagnosis

1. The following things are interlocked to turn off the rack power in the Electronics House:
   (a) VESDA rack smoke alarm
   (b) Temperature too high (54°C.)
   (c) Rack temperature controller out of range.
   (d) Crash buttons

   and of course the Electronics House power will be off if there is a general power outage. In this last case, EH power should return when the general power does, although many crates will be off. Please see section 26.4.

2. If the klaxon sounded indicating a Fire alarm, you must *not* go into the hall. Instead go outside and meet the fire-fighters. Once they have cleared the alarm and given permission you may proceed.

3. If zone 2 is out (racks 13 to 28), open all the doors on racks 15 and 16.

4. Determine the cause of the power outage
   (a) VESDA alarms
      i. Resolve the smoke problem if any. The EH VESDA smoke alarm is located at eye level on the outside of the SE corner of the EH. The Detector VESDA unit is on the outside of the SW corner of the EH. The IR2 VESDA unit is on a post next to the south wall of the assembly hall next to the heat exchangers and chillers.
      ii. If the EH VESDA has an Action, Fire1, or Fire2 alarm, the matching EH zone has been tripped. If it has a Fire1 or Fire2 alarms the fire department has been summoned and the evacuation klaxon sounded. If it has a Fire2 alarm the FM200 fire suppressant has been released.

iii. The Detector and IR2 VESDA units trip the detector power and zones 1 and 3 of the EH.

iv. The VESDA heads suffer from cross zone bleed. Large smoke levels in one zone will appear at a level 10 to 20 times lower in the next sampled zone. The sampling order is 1,2,3,4,1,...

v. The VESDA heads give the current smoke level in percent obscuration per meter. The alert level is 0.08%, the action level 0.14%, the fire1 level 0.20%, and the fire 2 level 2.00%.

(b) If just a portion of the EH power is off, it is probably due to one of the interlocks listed at the beginning of this section.

(c) The state of the VME crates are the quickest indication of what is off. Their state can be quickly scanned on the Control Crates and DAQ Crates EPICS panels (reached via the Central Systems Panel).

i. Zone 1 (racks 1 to 12) house power drives crates such as EMC-MON. The crates in rack 9 are on zone 1 UPS.

ii. Zone 2 (racks 13 to 28) house power drives the DAQ crates. CEN-BIP in rack 18 is on zone 2 UPS. The ethernet switches in rack 16 are on both.

iii. Zone 3 (rack 29 to 40 on the roof) house power drives SVT-MON. The DRC SOB interlocks in rack 38 are on zone 3 UPS.

(d) Check circuit breakers (panels on the ends of the rack rows) to see if any have tripped.

(e) THINK

5. For non-VESDA alarms, the state of the SIAMs in CEN-ILK (rack 9) will give a quick diagnosis of the source of the trip.

6. Log the cause of the power outage if you can figure it out.

Power recovery

1. First call the system on-call experts for the affected systems. Zone 1 affects everyone except the SVT. Zone 2 probably does not need an expert, but some help may be needed with DAQ. Zone 3 affects the SVT and the DRC.

2. Clearing VESDA alarms

   (a) Resetting VESDA alarms:

   - Fire alarms must be reset by the fire department before you may enter the IR2 assembly area. The fire fighters may need the assistance of the fire alarm technicians. The non-emergency fire department number is 2776.
   - The output from the VESDA to BaBar is non-latching, but there are latches in the path to the UPS contactors. These may be reset by pushing the buttons inside the box labelled “UPS bypass” located on the south side of the outside of the EH at chest height. Do not do so until you have eliminated

the possibility that the source of the smoke is a device powered by UPS, since resetting this unit will immediately restore UPS power (restoring main power requires some extra steps).

- The SIAMs which report VESDA status will capture the alarms for diagnostic purposes.
- Once the VESDA alarms have been cleared, and UPS power reset. Turn on the CEN-MON and CEN-ILK VME crates in rack 9.

3. If SIAMs 2-7 in CEN-ILK have tripped channels, you will need to clear (strongly preferred) or bypass them to reset the power. See section 21.4.1 for instructions. If the power has been off for a while on a cold day, some racks may be too cold. In this case, bypass the shunt trip SIAMs for any zone that is off. Racks 1-12 comprise zone 1, racks 13 to 28 comprise zone 2, and racks 29-40 comprise zone 3. The bypass switches are located in the upper back of rack 6; up is bypassed, down is normal. *Do not do this unless you understand exactly what conditions are being bypassed and the implications of these conditions. Otherwise, consult a central system expert.*

4. Reset all tripped panels by turning the main breaker at the top of the panel off then on. If the breaker won't latch in the off position, move it to the on position, then to the off position. *Be sure to use the Personnel Protection Equipment indicated on the panel.* The breaker panels for the three zones are:

   (a) Zone 2: two panels, inside EH, NE corner, PB620B-03 (*do this one first*)and PB620B-02, and one UPS panel in the SE corner.

   (b) Zone 1: two standard panels, inside EH, SW corner, PB620B-04 and PB620B-04A, and one UPS panel. -04A is a slave to -04 and can only be reset once 04 has been reset.

   (c) Zone 3: two panels, top of EH, one on each end of the racks, PB620B-05, PB620B-06, and one UPS panel near the floor opposite rack 40.

5. Reset any remaining tripped SIAMS in CEN-ILK (rack 9).

6. *UNDO* any shunt trip SIAM bypass(es) in the back of rack 6.

7. Close the front and back doors of racks 15 and 16 in the EH.

Turning the electronics back on

1. Turn on the CAEN HV supplies (racks 5, 6, 8, 11, 29, 30, 31, and 32) on one by one (if they were on), but don't raise the voltages at this time. You may wish to let the system experts do this. There are some tips below and more instructions in the system web pages: DCH, DRC, EMC. Some of these must be functioning before their controlling IOCs will boot. Some tips:

   (a) If the general UPS was off, the xyplex terminal server may have garbage in its buffers which will prevent some CAEN supplies from booting. The affected mainframes are the DCH (dch-hv), the DRC (drc-caen1..drc-caen6), and the

IFR (ifr-caen1..ifr-caen4) units. xyplex to each port, e.g., `xyplex -f dch-hv`, then `ctrl-]` to disconnect, and then `quit` to leave telnet.

(b) Now the CAEN supplies may need to be rebooted. On some, for example the SVT mainframes, the CAEN-net lemo cable should be unplugged at the VME interface before doing this, and then replaced afterward. The rebooting may be induced by keying the mainframe off, then on.

2. Turn on all 6U VME crates. There are such crates in zones 1 and 3 (racks 1-12, and on the roof, racks 29-40).

    (a) If the UPS in zone 1 was off, the xyplex terminal server may have garbage in its buffers which will prevent the IOCs from booting. xyplex to each port, e.g.,`xyplex -f cen-mon`, observe, and for IOCs, give the `ctrl-X` boot command if necessary, then `ctrl-]` to disconnect and then `quit` to leave telnet.

    (b) The complete list of IOCs and their status may be read from the odc-main→CEN→Control Crates EPICS display. The vertical bar on the left side of each crate indicates the IOC state. RED is not good. Click on details. A white display indicates that booting has not completed.

3. Turn on LV supplies (racks 1-3, 11, 29-32) (if they were on before the outage).

4. IF THE MASTER CRATE HAS POWERED OFF (also known as FCTS or FCT crate) follow the instructions in the DAQ Shifters manual $BFROOT/www/Detector/Operations/shifts/DAQDoc/BaBarDAQOperations.html. Otherwise, turn on all 9U VME crates that were on before the outage (normally all of them). Contact the system experts if you are uncertain which devices should be on .

5. The system people will need to bring all voltages into their operating state.

6. Calibrate all systems before taking data. Re-calibrate all systems at the first opportunity once the crates have warmed up.

7. Do a test run to provide a final check that everything is OK.

Appendix A

Glossary

Access Entry into the IP area.

ALARA (As Low As Reasonably Achievable) DOE and SLAC policy for exposure to hazards.

Altera brand of Field Programmable Gate Array

Ambient Database The history of some of the data collected by EPICS. It is indexed by time.

Annunciator, alarm The alarm annunciators are light panels which indicate serious alarm conditions. They also drive a door bell sound via the public address system.

BCS (Backup Cooling System) Two large heat exchangers, which are used as backups for the EMC fluorinert chillers, the EMC barrel water heat exchanger (aka chiller), the DCH heat exchanger (aka chiller), and the DRC chiller. This is not to be confused with the accelerator's BCS (Beam Containment System). Oops!

Beta Alarm The brand of alarm panel once used as the alarm annunciator. These have been replaced with custom built units.

BIC (Bunch Injection Control) The program the accelerator operators use to control injection. It shakes hands with the BISM.

BIP (BaBar Interface to PEP) The detector control IOC which communicates with PEPII EPICS.

BISM (BaBar Injection State Machine) This EPICS function manages the interaction between BaBar and PEPII from the BaBar side.

Blackout Deliberate elimination of all outside electrical power.

BLT (Binary Link Tracker) A part of the DCH based trigger. It finds tracks based on continuity.

Brown-out Required reduction in total laboratory electrical power usage. Usually requires cessation of accelerator operations.

CC (Controller Card) The part of the ROM which contains the inteface to the FCTS.

Conditions database Non-EPICS non-event data which is indexed by time. Calibration constants are an example.

Configuration database Data which is indexed by the configuration key. The map of crates in the partition is an example.

Console The structure in the control room at which the experiment is monitored and run.

Control Room The room with the console and other workstations for running the BaBar detector.

Controlled access Key controlled access to the IP area.

Counting House Building 621 which is attached to the IR2 hall (Building 620). The first floor of the counting house houses the Control Room and the Cornelius conference room. The second floor houses the rest rooms, the kitchen, and the maintenance area.

CWR (Chilled Water Return) Water coming from the IR2 chilled water plant to various heat exchangers in the hall. The chilled water is used for building air conditioning and for cooling electronics.

CWS (Chilled Water Supply) Water returning to the IR2 chilled water plant from various heat exchangers in the hall.

CMLOG Software that collects the error messages generated in various parts of the BaBar online system and displays them centrally.

Cryo (Cryogenics Group) The group responsible for the superconducting magnet. They always have someone on shift.

DAQ (Data Acquisition) Loosely defined term describing the ensemble of systems which brings the data from the front ends to a disk file. Generally includes DFL, OEP, L3, ORC, and a subset of ODC.

DAQ Crate 9U VME crate which houses ROMs.

DIM Distributed Information Management, a method of facilitating communication in distributed/mixed envirnoments. It provides a network- transparent inter-process communication layer.

DNS (DIM Name Server) The entity which facilitates communication between software in the DIM domain.

DCH (Drift CHamber)

DCT (DCH Trigger) The portion of the level 1 trigger based on signals from the drfit chamber.

DIRC Detector of Internally Reflected Čerenkov light, the particle ID detector.

DOE U.S. Department of Energy. SLAC's funding agency.

DRC Shortcut for DIRC.

EFD (Experimental Facilities Department) A group which supports experimenters at SLAC. It is part of the Research Division. The Cryogenics Group is part of EFD.

EH Electronics House. The building on the IR2 hall floor which houses the off-detector electronics. There are electronics on the first level and electronics and utilities on the roof.

EMC (ElectroMagnetic Calorimeter)

EMT (EMC Trigger) The portion of the level 1 trigger based on signals from the EMC.

EOIC (Engineering Operator In Charge) The person in charge of the shift crew at MCC.

Event database This is the event data. It is indexed by time.

FPGA (Field Programmable Gate Array) An integrated circuit, which can be programmed to implement complicated logic.

Fragment The collection of event data from one logical DAQ crate.

FCDM (Fast Control Distribution Module) Interface between the FCTS and a DAQ crate.

FCGM (Fast Control Gate Module) Interface between the trigger and the FCTS.

FCPM (Fast Control Partition Master)

FCPR (Fast Control Partition Router) Connection between the FCPM and the FCDM.

FCTM (Fast Control Timing Module)

FCTS (Fast Control and Timing System) The set of electronics which connects the trigger system with ROMs and synchronizes the experiment with PEPII. The major components are the FCTM, the FCGM, FCPMs, FCPRs, and FCDMs. It is part of Online Data Flow (ODF).

FEE (Front End Electronics) The system electronics responsible for amplifying, digitizing, and selecting time slices from the detector signals.

FM200 (heptafluoropropane, aka HFC-27ea) A fire suppressant gas. It is an ozone layer friendly HALON substitute.

GMS (gas mixing shack) The building next to the utility pad and the ring road in which the DCH and IFR gases are prepared.

HVAC (Heating Ventilation and Air Conditioning group) The group responsible for heating and cooling. Among many other items, they maintain the chilled water plant on the IR2 utility pad.

HAD (Hazardous Atmosphere Detector) Device to detect flammable gas mixtures.

IFR (Instrumented Flux Return) The muon and neutral hadron detector.

IOC (Input Output Contoller) The basic EPICSl data gathering processor. In our case they are all Motorola MVME 177 SBCs.

IP (Interaction Point) The area in the IR2 hall behind the radiation wall where the detector and PEP II collision point are located.

IR2 The PEP II interaction region in which BaBar is located.

Klixon A temperature activated switch used for protection from overheating.

Main drive line The primary 470 MHz accelerator clock. We derive our timing signals from this clock.

MCC (Main Control Center) Where both the LINAC and PEPII are controlled.

No access The IP area is closed to entry. Beam may come at any time.

Objectivity The object-oriented database program we use to store most things.

ODC (Online Detector Control) The system comprising the hardware and software which monitors detector conditions other than data quality.

ODF (Online Data Flow) The system comprising the hardware and software which moves the data from the FEE to the farm nodes.

ODM (Oxygen Deficiency Meter) .

OEP (Online Event Processing) Software that receives the data from the event level of the DataFlow and performs various processing on them. One of the most important function of the OEP is to write the data into XTC files.

OHP (Operational Health Physics) The SLAC group responsible for monitoring and minimizing radiation exposure.

OPR (Online Prompt Reconstruction) The system consisting of computers and software used for low latency reconstruction of the data.

ORC (Online Run Control) Software that controls the BaBar online system. It is started when you type `runOrc`. The X11 GUI is often called (loosely) "the Orc window".

ORCA brand of Field Programmable Gate Array

PA (Public Address system) The public address system sounds throughout the counting house, the hall, and in the EH. It has sources from the phone system (x164), the microphone on the console, a workstation (bbr-con01), and the annunciator panel.

PAFD (Palo Alto Fire Department) The PAFD runs the 9911 service and has a station at SLAC.

Partition Subset of the BaBar detector (usually one or more systems) that runs together to take data. A partition is identified by a crate mask, a 32-bit word in which each bit represents a DAQ crate that are participating in the partition. A partition is formed by the Run Control on INITIALIZE, and dissolved on CLOSE PARTITION

PED (Plant Engineering Department) The group responsible for the design and maintenance of major infrastructure at SLAC. Now merged into SEM.

PEP II (Positron Electron Project II)

Permitted access Free entry into the IP area.

PIC (Person In Charge) The responsible party during an emergency. Normally this is the MCC EOIC.

Platform The complete set of dataflow hardware which is available to be included in a partition in a given environment.

PPS (Personnel Protection System)] The hardware system that prevents access to the IP and accelerator housing when beam is present.

Proxy Proxies facilitate control and monitoring between the upper levels and lower levels; "upper Levels" refers to Run Control and User Interfaces while "lower levels" refers to VxWorks domain and DAQ processes.

PTD (PT Discriminator) A module which is part of the DCT. It finds tracks based on curvature.

ROM (Read Out Module) BaBar standard DAQ module that connects to the front-end electronics via optical links and reads out event data. A ROM consists of an SBC, a CC, PMC, and either a TPC or a UPC.

RWR (rack water return) Water returning from the rack heat exchangers to the EH heat exchanger.

RWS (rack water supply) Water going to the rack heat exchangers from the EH heat exchanger.

RWT (Radiological Worker Training) Training required before performing any tasks that might result in measurable radiation exposure.

SAD (Safety Assessment Document) Formal safety evaluation required by the DOE.

Segment In DFL this is a collection of event data from one ROM after feature extraction. In the DCT, this is a one super-layer of a DCH track.

SBC (Single Board Computer) We use one type as EPICS IOC's and another type as a part of the ROMs.

SEM (Site Engineering and Maintenance) The SLAC group responsible for infrastructure such as water, air conditioning, AC power, etc.

SIAM (Smart Interlock and Alarm Module) BaBar standard module for the named use.

SL (Shift Leader or Super-Layer) A super-layer is four adjacent layers of the DCH, all with the same stereo angle.

SVT (Silicon Vertex Tracker)

TLA (Three Letter Acronym) e.g., "DCH".

TLD (Thermoluminescent Dosimeter) The radiation badges we are required to wear when in IR2 hall.

Trimmed Farm Node A Farm Node which, either due to a software or hardware crash, has ceased to take part in the Level 3 Trigger.

TRG The trigger system.

TSF (Track Segment Finder) The first module is DCT data path. There are two variations designated TSFX and TSFY.

UPS Uninterruptable Power System

VESDA (Very Early Smoke Detection Apparatus) A type of smoke detector. It samples via pipes and uses a laser to detect smoke.

VSAM (VME Smart Analog Module) BaBar standard scanning ADC. module.

Xilinx brand of Field Programmable Gate Array.

XTC (eXtended Tagged Container) files Files containing only raw data. These are the product of OEP and the input to OPR.

Xyplex Network device that connects RS232C ports to ethernet. Typing `xyplex port-name` at a Unix prompt connects you to the ROM, IOC, or Farm machine attached to the `portname`, where port-name is something like `odf-dch`, `odf-pp1`, etc. Note that only one connection can be set up for each port, i.e. you cannot connect to a ROM using xyplex while someone else is using it. To close a xyplex connection, type control-X to get a telnet prompt, then type `quit`.

Appendix B

Annunciator Alarms

System	*Alarm*	*Source*	*Location*	Comment
SVT	Summary (22.4)	SVT ILK	EH 34	Environment out of tolerance
DCH	Gas (21.6.2)	nanoautomate	GMS 2	DCH gas system problem
	Chiller (21.6.3)	DCH MON	EH 10	DCH chiller problem
DRC	Chiller (21.7.2)	DRC MON	EH 7	DIRC chiller problem
	SOB H2O (21.7.3)	DRC GAS	EH 38	SOB dumped
EMC	Brl Chl (21.8.3)	EMC ILK	EH 4	An EMC chiller problem
	EC Chl (21.8.3)	EMC ILK	EH 4	An EMC chiller problem
	BCS Flu (21.8.3)	EMC ILK	EH 4	An EMC chiller problem
IFR	RPC Gas (21.9.1)	CEN GMS	GMS	IFR gas system problem
	LST Gas (21.9.2)	IFR MON	EH 4	LST gas system trip
CEN	CHL (21.4.6)	CEN MON	EH 9	Chilled water failure
	GMS (21.4.4)	CEN GMS	GMS 1	GMS problem
	EH (21.4.1)	CEN ILK	EH 9	EH problem
	IR2 (21.4.3)	CEN MON	EH 9	water on IP floor
	Rack Water (21.4.2)	CEN MON	EH 9	Rack water problem
VESDA	EH (21.3.1)	CEN ILK	EH 9	smoke in the EH
	DET (21.3.2)	CEN ILK	EH 9	smoke in the detector
	IR2 (21.3.2)	CEN ILK	EH 9	smoke in the IP
	LST (21.3.2)	CEN ILK	EH 9	smoke in the LST racks
MAG	Magnets (21.4.5)	CEN CRY	Cryo	Magnet problem
BCS	LCW (21.4.7)	CEN MON	EH 9	BCS LCW problem

Appendix C

IOC boot table

If an IOC needs to be rebooted because of resource warnings, it can probably wait for a convenient time. Generally no IOCs should be rebooted during active DAQ. Some may be rebooted during a pause, others should wait until there will be at least 5 minutes between runs. Still others should wait until there is no beam, e.g., DCH-MON.

If the there is a serious problem, such as lost communication with a CAEN supply, the run will have to be stopped and the IOC rebooted regardless of the disruption.

It is preferable for the system controls experts to reboot IOCs. The Pilot may do so if necessary and the instructions are clear.

The "Boot?" and "AC cycle?" columns indicate if the operation can be performed without disruption during a pause in the DAQ.

IOC	*Functions*	*Boot?*	*AC cycle?*	*Comments*
SVT-MON	M IJ R C	no	no	see note 3
SVT-ILK	I IJ R	no	no	see note 4
SVT-LV	HVB IJ R	no	no	see note 5
DCH-MON	M I HV IJ R	no	no	see note 6
DCH-GAS	M R	no	no	
DRC-MON	M A	yes	yes	see note 7
DRC-HV	HVB	yes	yes	see note 8
DRC-GAS	M A	yes	yes	on UPS; see note 9
EMC-MON	M R	no	no	
EMC-ILK	I HV R	no	no	
IFR-MON	M I IJ R	no	no	
IFR-HV	M HV IJ R	no	no	
LST-HV	M HV IJ R	no	no	
CEN-MON	M A R	yes	yes	on UPS
CEN-ILK	I	yes	no	on UPS
CEN-BIP	C I IJ	no	no	on UPS, see note 11
CEN-CRY	M I R	yes	no	see note 12
CEN-GMS	M I	yes	no	
PEP-TIM		na	no	no IOC
PEP2	C			not our crate

Key to the functions:

Letters	*function*	*consequences*
M	monitoring	monitoring is lost during a reboot (see note 2)
I	interlock	interlock will be activated if crate is off
A	alarms	turning crate off will cause a hardware alarm
HV	CAENnet interface	power supplies will be set to zero by a reboot
HVB	CAENnet interface	power supplies will *not* be affected by a reboot
IJ	crate can affect injection	injection may be prevented during a reboot
R	crate can affect the runnable flag	DAQ may stop during a reboot
C	PEP communication	may affect injection and PEP monitoring

Notes:

1. Cycling the crate power causes a reboot.
2. Rebooting any IOC will cause EPICS alarms. These will be particularly extensive for those crates with monitoring functions.
3. Rebooting SVT-MON will take at least 5 minutes. Be patient. If more than one SVT- IOC needs rebooting, SVT-MON should be rebooted last. Special reboot procedure for SVT-MON:
   (a) why re-boot? if ioc is hung, all svt-epics is WHITE and not responsive.
   (b) try to contact the SVT commissioners immediately. they will be automatically paged within 5 minutes anyway.
   (c) connect and verify prompt
   (d) if crashed, may not receive prompt, so make a note and go on
   (e) so do `CTRL-X` to start re-boot
   (f) should see the vxWorks boot screen after a few moments
   (g) if system hangs and does not return completely after 8 minutes, and boot-screen doesn't eventually terminate in a prompt, the boot-cycle has properly hung. this has been seen; you may actually lose xyplex and/or ethernet support. visit the crate and manually reset the IOC.
   (h) once properly booted, wait for all red EPICS warnings to clear (may take up to 60 seconds)
   (i) if SVT looks okay, don't forget to put detector back in AUTO mode or else it will ignore BaBar global request to go_RUNNABLE or go_INJECTABLE. Do this by States $\rightarrow$ Control Options and choose AUTO.
   (j) if the re-boot looks full of errors, you should have already contacted the SVT commissioner(s) to start the re-boot, and you'll need their help right NOW.

   Note that the SVT-MON VME crate also contains the SVT-LV IOC.
4. If more than one SVT- IOC needs rebooting, SVT-ILK should be rebooted first.

5. Unlike reboots of other IOCs that control CAEN supplies, SVT-LV reboots are bumpless. On the other hand, the SVT CAEN supplies may not be power cycled while their CAENnet is connected to a running SVT-LV. SVT-LV is in the SVT-MON VME crate.

6. Suggestions for an emergency reboot of DCH-MON under beam conditions:

   (a) BYPASS the DCH injectable flag using the button on the BaBar State Machine panel. Currently this button can only be pushed by certain DCH experts, or babardch. This protection is open to modification if you feel that there is a need.

   (b) Logon to the IOC `xyplex -f dch-mon` and type `Ctrl-x`. After the IOC is finished booting type `Ctrl-]`, which brings you to the `telent>` prompt where you type `quit`. Do not under any circumstances type `logout`.

   (c) Ramp the chamber to injectable under local control. If everything looks ok return the chamber to global control. *If* all of that works, then finish by un-bypassing the DCH from the BaBar State Machine panel.

   This reboot procedure should only be performed if the IOC crashes and *all* of the DCH channels are disconnected. If HV control is still possible then the chamber should be ramped down under controlled conditions before being rebooted.

   If the IOC is *really* stuck, or beams are so bad that the pilot feels he/she should try to ramp down the chamber at any cost before rebooting, then

   (a) Walk to the electronics hut, momentarily unplug the LEMO cable going to the CAEN INTERLOCK input, and plug it back in.

   (b) Press the IOC reboot red button, or reboot it through xyplex.

7. The DIRC MON IOC controls 12 PMT hit rates (1 / sector, the scalers), the low voltage, temperature and status of the FEE boards and crates, the values of the magnetic sensors and the light transmission intensity of the optical fibers through 2 daisy-chained CANBUS systems, one on the Wiener FEE crates and the other on the DCCs. In addition, it controls the gas humidity and flow readout as well as the SOB status.

8. The DIRC HV IOC controls the HV configuration and status.

9. The DIRC Gas SIAM IOC controls the SIAMs of the various gas humidity sensors.

10. If there has been a UPS outage, the xyplex ports may be in a bad state. `\xyplex -f` to each IOC and each xyplex connected CAEN supply before rebooting. One may disconnect immediately after the connection is established.

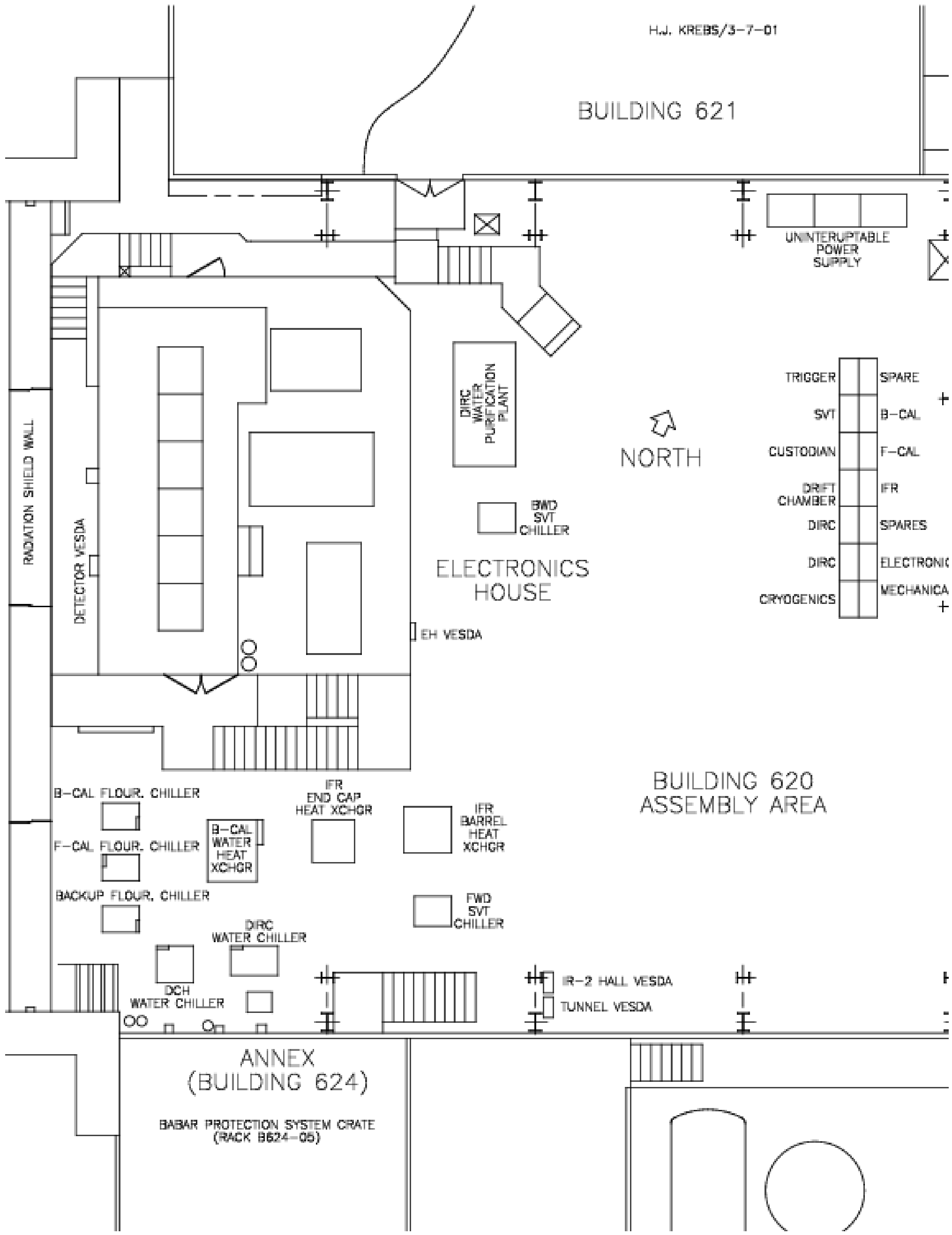
11. CEN-BIP is “owned” by ODC. The other CEN- IOCs are owned by the central system.

12. Turning off the power to this crate will cause the solenoid magnet and the bucking coil to ramp down

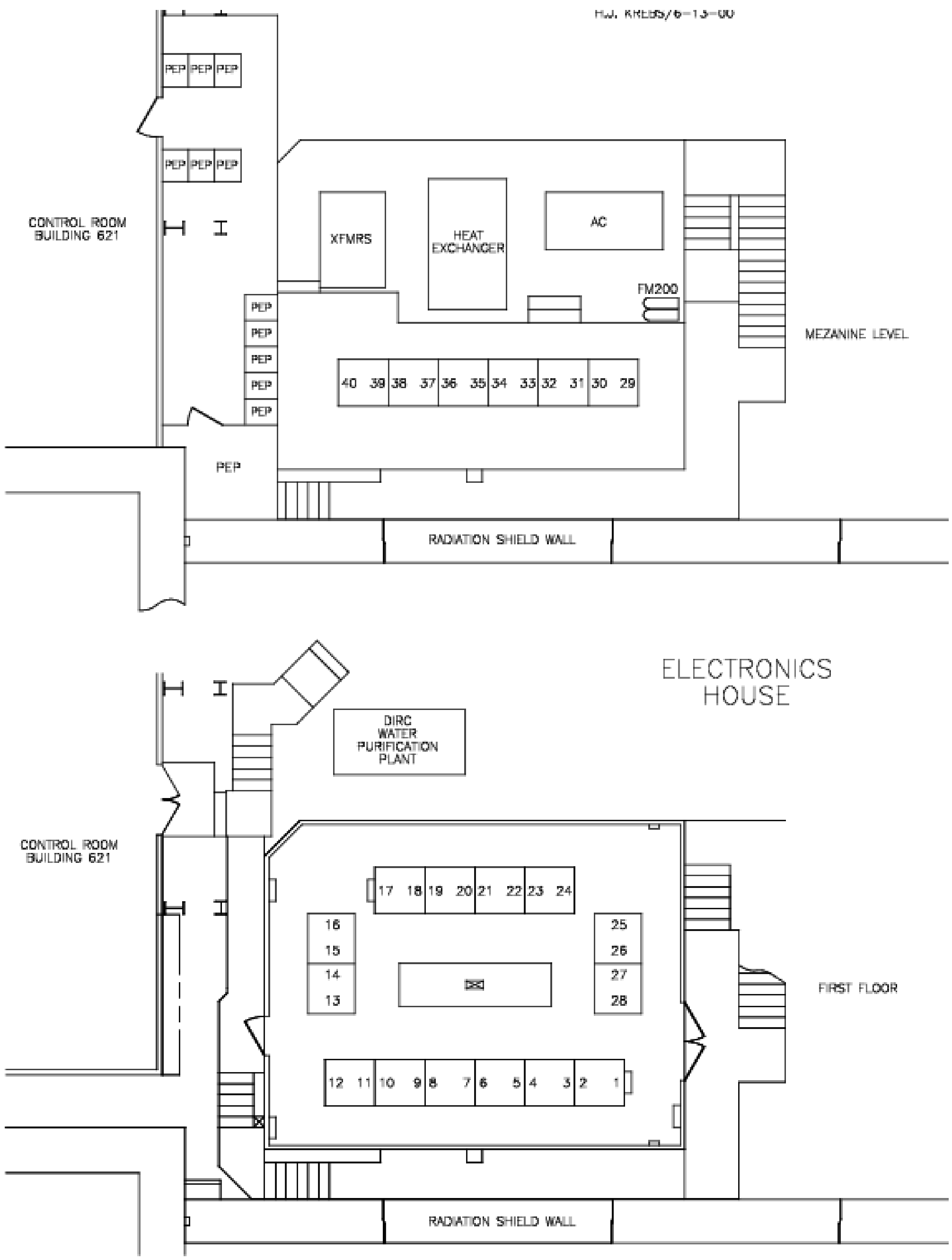
Appendix D

Maps of BaBar

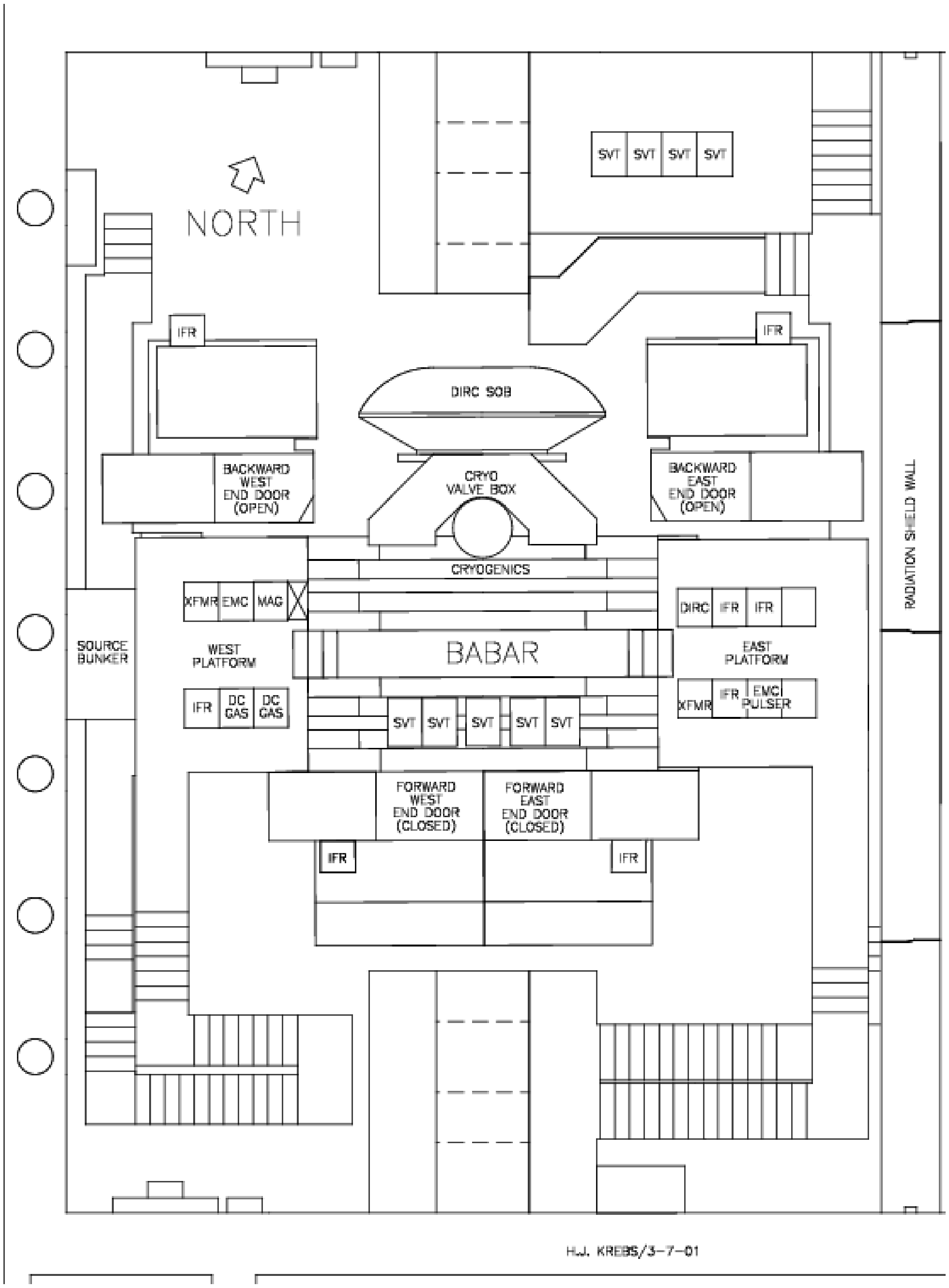
D.1 The Assembly Area of Building 620 (IR2)



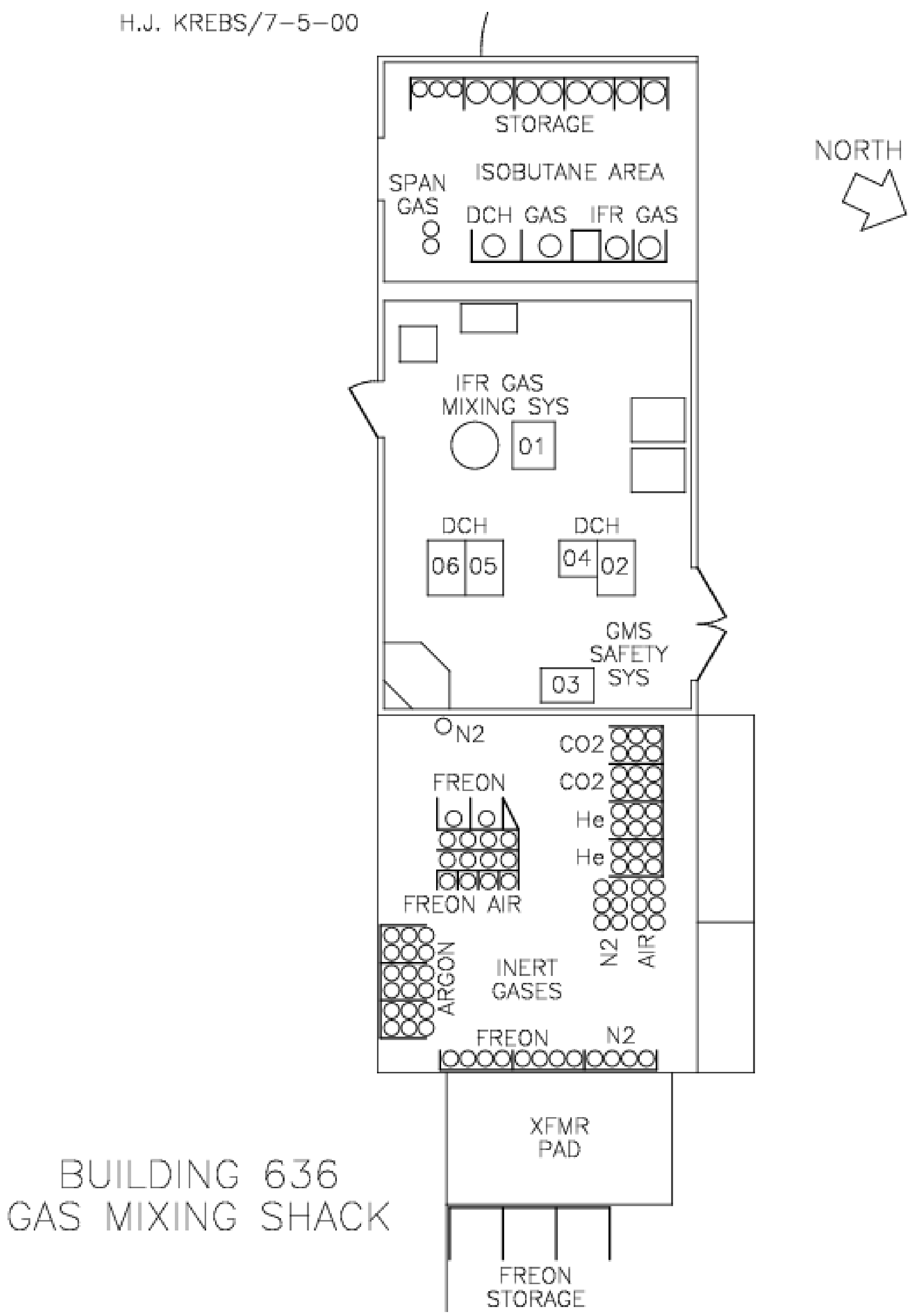
D.2 The Electronics House



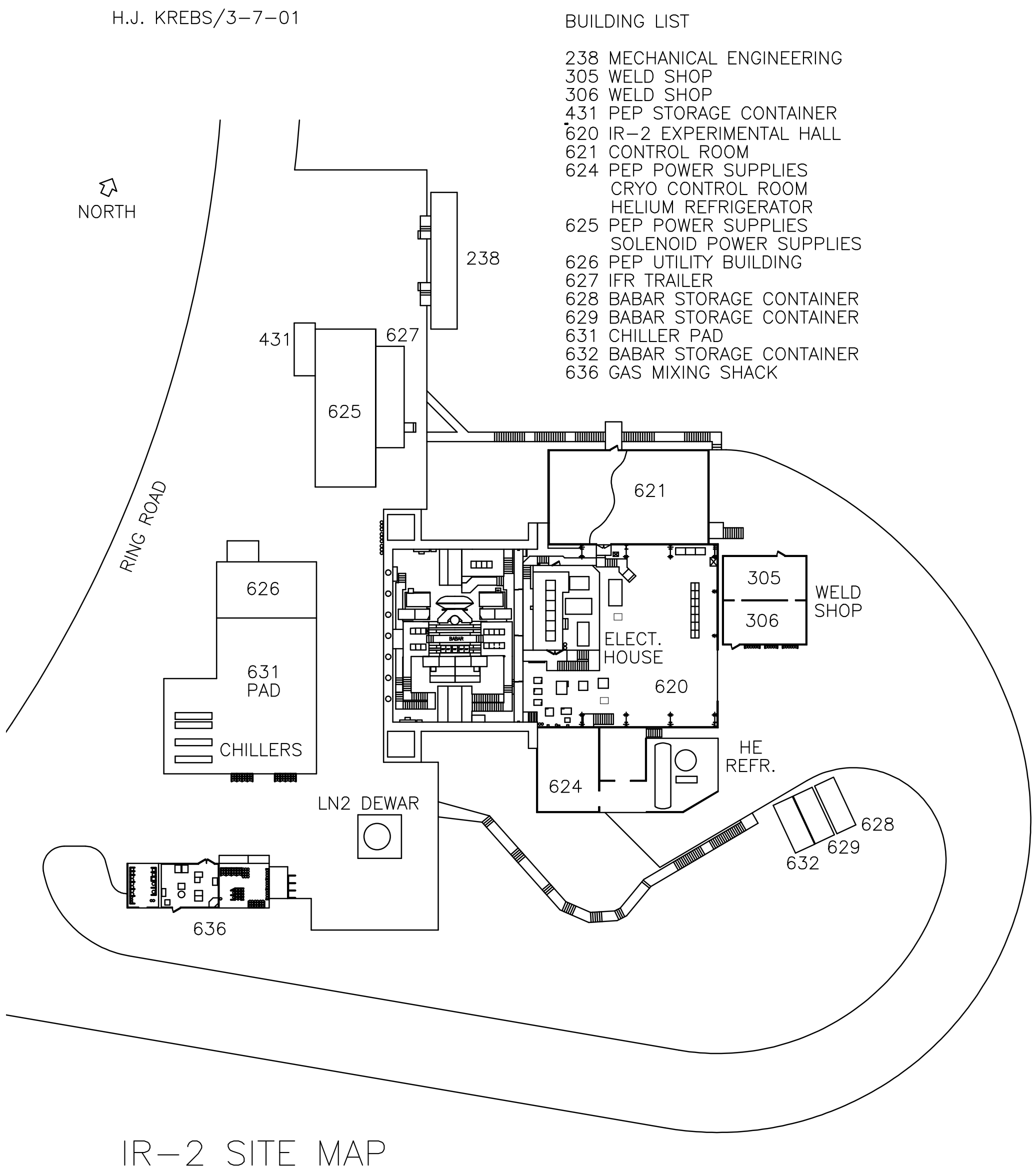
D.3 The IP Area



D.4 Gas Mixing Shack Map



D.5 Site Map


H.J. KREBS/3–7–01
BUILDING LIST
238 MECHANICAL ENGINEERING
305 WELD SHOP
306 WELD SHOP
431 PEP STORAGE CONTAINER
620 IR–2 EXPERIMENTAL HALL
621 CONTROL ROOM
624 PEP POWER SUPPLIES
CRYO CONTROL ROOM
HELIUM REFRIGERATOR
625 PEP POWER SUPPLIES
SOLENOID POWER SUPPLIES
626 PEP UTILITY BUILDING
627 IFR TRAILER
628 BABAR STORAGE CONTAINER
629 BABAR STORAGE CONTAINER
631 CHILLER PAD
632 BABAR STORAGE CONTAINER
636 GAS MIXING SHACK
NORTH
RING ROAD
238
431
627
625
621
626
631
PAD
CHILLERS
ELECT.
HOUSE
620
305
306
WELD
SHOP
HE
REFR.
624
LN2 DEWAR
628
629
632
636
IR–2 SITE MAP

Appendix E

Scheduled Blackout

"Blackout" means that all power from the electrical grid will be cut off. For BaBar, this means that we will have no power except that we provide ourselves, i.e., the main UPS power and a few batteries.

E.1 Preparation for a Scheduled Blackout

It is expected that the shifter will receive instructions to prepare for a blackout from the run-coordinator, but if the shift crew is contacted and informed that a blackout has been announced, before taking action they should
`telalert -i babarrunc -m ''Have been informed of blackout at hh:dd''`.
Each subsystem expert (listed below) should then be paged. Once MCC drops the beams to begin preparing for the black-out, each subsystem's contingency plans should be enacted.

E.1.1 SVT

Upon receiving notice of a blackout page the SVT Commissioner at 849-9407. Only if there is not time to wait for a response should you continue with the following steps.

1. Go HDIs→ Power_OFF using the SVT State Machine
   Some modules might trip at this point so it is a good idea to have an expert around or at least on the phone at this point.

2. go Power_OFF → Cooling_OFF using the SVT State Machine

3. Turn the twelve SVT CAEN crates OFF (turn the key to OFF). These crates are in the three leftmost racks on the roof of the Electronics Hut.

4. Shut down the chiller by pressing the two big red buttons in chiller reset crate on the roof of the Electronics Hut (rack next to the CAEN power supply crates) to prevent Auto-switching ON of the chiller (this has been observed).

5. Switch off the three IOCs located in the rack next to the CAEN racks by turning off the two Wiener VME crates.

6. Switch off the SVT monitoring board control panel (back of B620B-33 rack).

E.1.2 DCH

Upon receiving notice of a blackout, page the DCH commissioner at 846-0981 and the DCH Gas system expert at 377-9893. Wait for them to respond. The DCH has no actions to be performed before a blackout, so **wait for the power to die before performing the following actions**

1. Switch off the power for the DCH LV module at the bottom of rack B620B-11 : Low voltage supply (Blue BOX).

2. Switch off the power for the DCH HV module at the top of rack B620B-11 : High voltage supply (CAEN crate).

E.1.3 DIRC

Upon receiving notice of a blackout, page the DIRC Commissioner at 846-0545. You do not need to wait for a response. Carry out the following actions once the beams have been dropped and MCC begins preparations for the blackout.

1. From the main BaBar EPICS panel click on DRC to open the DRC Slow Control Monitor.

2. Click the 'ON/OFF' button at the lower right which opens a new window for the DIRC Power Screen. This screen is used to turn the whole DIRC on or off. For turning the DIRC on you work your way from the top to the bottom, to turning it off from the bottom to the top.

3. At the point on the panel labeled **3c** 'Turn HV on' press the off button. The twelve green control lights should turn red after a little while.

4. At the point on the panel labeled **2** 'FEE Status' press the off button. The twelve green control lights should turn red after a little while.

5. Completely turn off the HV power supplies by keying off the CAEN supplies in Electronics House ground floor racks 05 and 06.

6. Turn off the DIRC chiller in the far corner of the IR-2 Hall. The FEE crates are still connected to power, so that they can be turned on remotely again. They can only be switched off by pulling the breaker. With the chiller off there may be temperature alarms, but these will stop when the power is cut.
   The SOB is connected to UPS so there is no danger of a dump for power outages of less than six hours.

E.1.4 EMC

Upon receiving notice of a blackout, page the EMC shifter using the number on the whiteboard. You do not need to wait for a response. Carry out the following actions once the beams have been dropped and MCC begins preparing for the blackout. In the Electronics Hut, turn off each of the 100 LV power supplies in rack B2603-01 -02 and -03 by pressing the button on each panel and then powering off the crate.
This is to ensure that, when the power comes back, the chillers are working properly before the FEE is powered up.

E.1.5 Solenoid

Upon receiving notice of a blackout, page the cryotech at 846-9907. Cryogenics require two hours notice to ramp down the solenoid safely. If the solenoid discharges rapidly then heat is dumped into the cooling liquid helium and this heat must be removed before the magnet can be ramped back up. This cooling adds about two hours to the recovery process.

E.1.6 IFR

Upon receiving notice of a blackout, page the IFR Commissioner at 849-9117.

E.1.7 Computing

Upon receiving notice of a blackout, page the on call computing expert using the number on the boards or, preferably,
`telalert -i name -m 'Blackout scheduled for hh:mm'`. Essential computing functions are on UPS. If the power dies before the expert responds to the page, follow the instructions for an unscheduled power failure.

E.1.8 Infrastructure

Response to a scheduled black-outs is the same as to an unscheduled power outage. See section 26.4.3.

E.1.9 Shift people

Get a flashlight (torch) out of the cabinet behind the pilot console.

E.2 Recovery from a Blackout

Following a power outage, care must be taken to switch things back on in the correct order to avoid catastrophic damage. Before an announced power outage, or during a power failure, all the subsystems should have responded to the page. An announced power outage will have an end time, so the subsystem experts should be ready and waiting to bring up their subsystem when the power returns. Should the power return unexpectedly the subsystems should be paged and, while waiting for them to arrive at IR-2, the shifters should communicate with MCC to assess the stability of the power systems - if the power outage was unexpected there may be 'false starts' with the power returning briefly before failing again. These should be ridden out with the detector shut down. Note that the systems will require the servers to be running before they can be restarted, so page the on-call computing expert **first**.

Otherwise recovery from a scheduled blackout is the same as an unscheduled one. See section 26.4.4.