

Cyclotron

NSD 88-Inch Cyclotron

Procedure

Title:		CAVE SEARCH AND SECURE PROCEDURE	
Procedure Number: 88-PRO-007	Revision: REV. 4.0	Revision Date: 1 June 2006	Page 1 of 5
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1.0 PURPOSE

At the 88-Inch Cyclotron complex there are several experimental Caves. In preparation to receive beam, one or more Caves must be searched and secured (SAS) to ensure no people are in side them. In general the SAS procedure is to have a searcher methodically search the Cave to look for people, hazardous conditions and to check the operational readiness of equipment. Once the searcher has verified that the Cave is ready for operation, then the searcher will secure the Cave to prevent anyone from reentering the Cave.

This procedure must be used before beam is delivered to an experimental Cave that has been open. This procedure must also be used when necessary to restore a Safety Chain Complete condition after a break occurs in the CAVE portion of the Cyclotron Safety Interlock Chain (as indicated by a Safety Chain lamp off at panel A2111 in the Cyclotron Control Room).

The intent of this procedure is to ensure that, when the Cyclotron and/or its Radio Frequency System (RF System) are operating, the Cyclotron staff and visitors are excluded from the Cave, thereby protecting them from prompt radiation.

The scope of this procedure includes having the searcher search the Cave to ensure no one remains in the Cave, and inspecting the Cave to ensure it is ready to receive beam, and then the searcher leaves and secures the Cave, and finally the searcher logs the result of the search in the Cyclotron Operation Logbook in the Control Room.

Following is a list of the Caves where this procedure is intended to be used:

- Cave 01/02
- Cave 1
- Cave 2
- Cave 3
- Cave 4
- Cave 4A
- Cave 4B
- Cave 4C

Throughout this procedure only the term "Cave" will be used to refer to the area being SAS. Specific Cave references will be used when necessary.

If the Operator in Charge (OIC) has any doubt about the presence of people in the Cave, the OIC **must** SAS the Cave before operating the Cyclotron or RF system.

This procedure is intended to be performed for the initial SAS of a cave prior to the initial introduction of beam to the cave. An abbreviated version of this procedure applies when the experimenter needs to briefly enter the cave during a run. In addition for certain experimenters a special Exception, the Two-Key Protocol (Section 4.2.4.), to this procedure can be used.

2.0 QUALIFICATION

This procedure is performed by a trained person familiar with the normal Cyclotron operational practices and the normal configurations of the Cyclotron equipment.

This procedure is to be performed by a qualified radiation worker, or the Principal Investigator or the Shift Experimenter or a Cyclotron Operator (a second radiation worker, operator, or a trainee, may accompany the qualified worker for safety or training purposes only.) Only people trained in this procedure may search and secure the Cave (the specific Cave they are trained for).

This procedure may be performed by the persons who have completed NSD1007 "Cave Search and Secure Procedure" training. The EH&S Training Reports database may be checked to find the names of the persons that have completed the required training for this procedure.

3.0 HAZARD REVIEW

The performance of this procedure should not subject personnel to increased hazards above those associated with entering a controlled area. Upon entering controlled areas the searcher must follow the established facility safety practices.

The performance of this procedure may subject personnel to the following potential hazards:

Radiation:

Hazard: After a run beam line components or experimental components may emit x rays, beta rays, and gamma rays as a result of becoming activated during the run.

Mitigation: Prior to entering a Cave the searcher must review the Cave Radiation Survey form at the Cave entrance. Plan the SAS to minimize the exposure to intense fields. Always seek to minimize the duration of exposure. Move safely but smartly; a quick in-and-out trip should be the goal. This procedure should not take more than a few minutes. The LBL ALARA (As-Low-As Reasonably-Achievable) Policy for personal radiation exposure applies to all entry into Caves where accelerated beam has been delivered.

4.0 PROCEDURE

4.1 Search and Secure Preparation:

4.1.1. Verify the Cave area is ready to be secured and all work in the Cave area has been completed. Verify the beam line is ready to receive the beam. Verify that those components that were taken out of service and have been returned to service.

4.1.2. Verify with the OIC that the Cave beam plug is closed and that the OIC is ready for the searcher to perform the SAS.

4.1.3. Prepare a Cave SAS checklist. The searcher will use the SAS checklist as an aide to the performance of the procedure. Complete the checklist as the procedure is performed and insert the completed checklist in the Cyclotron Operations Logbook. A Cave SAS checklist is shown in Attachment A. During an experimental run, when the experimenter enters the cave for experimental needs, the shift experimenter is responsible for verifying that all the people that enter the cave do leave the cave and the SAS checklist does not have to be filled out.

4.1.4. Take the CAVE Castell key from the CONTROL ROOM TRANSFER KEYS panel and go to the Cave to be searched.

4.2 Search and Secure the Cave:

To search and secure the Cave, proceed as follows:

4.2.1. Enter the Cave:

4.2.1.1. If the Cave door/gates are not fully opened then open the Cave door or any internal Cave doors or gates. Ask any people in the Cave to leave. Do not continue the search until everyone has left the Cave.

4.2.1.2. Enter the Cave to be searched at the main door (in many cases, the only door).

4.2.1.3. Close and secure all secondary entrances to the Cave, behind you, after you enter the Cave. Leave open the main, or usual, entrance.

4.2.2. Search the Cave:

4.2.2.1. Search the experimental Cave from the beam plug towards the main Cave door. Check that the beam plug pointer points to closed. As you move, search for any people remaining in the Cave. If anyone is found in the Cave, the search must start over, return to section 4.2.1., after they have left and the gate is again closed.

NOTE

Appreciate that people could be working out of sight. Look for people on ladders, or below the beam line components. Look inside the larger, open chambers, and in any niches formed by the shielding blocks.

The fluorescent white Cave lights will remain on throughout the search. These lights are essential for safe movement through, and an adequate search of, the Cave. After closing the Cave the white lights will switch off and red fluorescent lights will switch on as a visual warning of imminent/possible radiation in the Cave.

4.2.2.2. Search for any unsafe condition that exists or that could impair the safe and proper operation of the Cyclotron. Search for hazardous conditions, and general safety conditions, faulty lighting, and reviewing the general equipment conditions. Correct any safety concerns or operational readiness concerns found. The search must start over,

return to step 4.2.1., after the problems have been corrected.

4.2.2.3. As you pass the interlock system search stations (some Caves have as many as three), verify the RUN-SAFE toggle switches are in the RUN position: and that the associated amber beehive light glows. Replace any burned-out lamps as you find them, whether inside the Cave or at the Cave Door Control panel outside the Cave. The search must start over after the problems have been corrected. Return to step 4.2.1.

4.2.2.4. As you pass the EMERGENCY DOOR OPEN switch-lamps (always near doors, in Caves), verify that the red lamp in the switch is glowing. Replace any burned-out lamps as you find them. The search must start over after the problems have been corrected. Return to section 4.2.1.

4.2.2.5. As you pass floor gratings over the Cyclotron Trench (under Caves 1, 2, 3, or 5 only) verify that the grating is seated properly and is unobstructed. Keep the grating free of any boxes, carts, table legs, etc., that may shift, rock the grating, and break the Trench interlock chains.

CAUTION

Lifting a floor grating may trip any of four interlock switches in the two Trench Interlock Chain systems: this will trip off the 12 kV AC power to the RF System, requiring:

- A) search and secure the trench again (see *88-Procedure-006, Trench Search and Secure Procedure*),
- B) switch on 12 kV AC power, and
- C) retune the RF System.

4.2.2.6. Proceed searching toward the main Cave door, looking for any remaining people, or for any unsafe condition that exists or that could impair the safe and proper operation of the Cyclotron or the experiment. The searcher is to ensure that all other people have left the Cave and that no detectable hazardous condition exists.

NOTE

For SAS of Cave 4A or 4B: There is a floor-level gap (formerly a crawl hole) in the common shielding wall between Caves 4A and Cave 4B, near the beam plug end of the two Caves. This hole has been filled by stacking boric acid blocks to fill the passage. Verify that the stacked boric acid blocks are in place.

4.2.3. Secure the Cave:

4.2.3.1. Leave the Cave by the main door, closing the inner gate (if present) behind you.

4.2.3.2. Close the outer gate (if present) behind you, as you leave the Cave.

4.2.3.3. Close the Cave door (door operating instructions are posted near the Cave doors where required).

4.2.3.4. Outside the Cave, Verify the RUN-SAFE toggle switch is in the RUN position and the associated amber beehive light glows (at Cave Door Control panel and interlock system search station located just outside the Cave). Replace any burned-out lamps as you find them.

4.2.3.5. Remove the Castell key from the Cave Door Control panel (at the Cave door) and return to the Control Room with the key.

4.2.3.6. Insert the Castell key for the Cave just searched into the CONTROL ROOM TRANSFER KEYS panel and turn the key full cw.

4.2.3.7. Check that the Cave just searched has *beam plug permissive*. The permissive state is indicated by the READY lamp (glows green) for that Cave's beam plug switch at the BEAM PLUG CONTROL PANEL, A1241, in the Cyclotron Control Room.

4.2.3.8. Verify that the relevant Cave CHAIN COMPLETE lamp glows (assumes the Cyclotron Radiation Safety Interlock Chain is complete up through the VAULT XFER key portion of the chain), at the Radiation Safety Chain Interlock Panel.

4.2.3.9. Record the time that the Cave SAS was completed and sign the entry in the Cyclotron

Operation Logbook. This completes the Cave search.

NOTE

If anyone must enter the Cave, the OIC or the Shift Experimenter **must** ensure that everyone entering the Cave actually leaves the Cave. If the OIC has any doubt about the presence of people in the Cave, then the OIC **must** SAS the Cave before operating the Cyclotron.

Before anyone enters the Cave, the OIC must confirm that the beam plug is closed.

4.2.4 Exception:

The only exception is the "Two-Key Protocol" (outlined below).

4.2.4.1. TWO-KEY PROTOCOL

For some experiments a Two-key Protocol might be used if:

- (A). Approved on the Experimental Run Tracking Form, and
- (B). The experimenters are trained in this Search and Secure Procedure, and
- (C). The Shift Experimenter is listed as trained in this procedure, and
- (D). The OIC has recorded in the Control Room Operations Logbook that search and secure control rests with the Shift Experimenter.

4.2.4.2. The Two-key Protocol allows the OIC to issue a red-handled Castell key for the Cave in use to the Principal Investigator or his/her appointed Shift Experimenter. The PI and Shift Experimenter accept the responsibility to search and secure the Cave on leaving, and remove the key at the Cave door, before asking the OIC to open the beam plug. This saves considerable time and footwear when fairly frequent target or specimen changes are a necessary part of the experiment.

NOTE

Leaving the red key in place prevents the beam plug from opening.

5.0 RECORDS

Records generated by compliance with this procedure are to be in compliance with RPM, Section 1.18, Records Management. Records generated through implementation of this procedure consist of the entry in the Cyclotron Operations Logbook indicating the signature of the searcher and the time of the completion of the SAS. In addition the completed SAS checklist is kept in the Cyclotron Operations Logbook. The Cyclotron Operations Logbook is maintained in the control room by the Operations Supervisor.

6.0 REVIEW OF PROCEDURE

Under the guidelines for DOE Order 420.2B, this procedure will be reviewed at least once every three years, or sooner if changes occur that may impact the appropriateness or implementation of this procedure.

REVISION HISTORY

11 July 1996: V3.0 Converted all Cave search and secure procedures to a single, standard procedure and format.

21 January 2004: V3.1 Added specific items to Cave inspections prior to run.

1 June 2006: 88-PRO-007 was updated and approved as V 4.0 to reflect current operating practices and implementation.

7.0 GLOSSARY

ALARA Policy: The LBL ALARA (As-Low-As Reasonably-Achievable) Policy for personal radiation exposure. For the Laboratory ALARA policy see LBL Publication 3000 Section 21.3: ALARA Program at Berkeley Lab.

EMERGENCY DOOR OPEN SWITCH: A red, illuminated pushbutton switch located inside Caves fitted with concrete doors. The switch is mounted near the Cave concrete door at about waist height. A person trapped in a Cave can open the concrete door by pressing and holding this switch (there may be a delay of up to eight seconds in certain Caves before the door begins to move).

EXPERIMENT TRACKING FORM: A Cyclotron operating form, issued (signed) by the Cyclotron Pro-gram Head, identifying the Principal Investigator, Title of the experiment, authorization for the experimental run and the authorized operating conditions and limitations.

OIC: Operator-in-Charge

RED KEY: A second Castell key used when the Shift Experimenter is responsible for Search and Secure Procedure for a Cave. See *Two-Key Protocol*. This Castell key has a red T-shaped handle.

RF SYSTEM: The Radio Frequency System, the source of energy used to accelerate the ion beam inside the Cyclotron. RF energy creates the voltage on the dee electrode that accelerates injected ions and may accelerate stray ions (dark currents).

SAFETY CHAIN INTERLOCKS PANEL: The Cyclotron Radiation Safety Chain Interlock Panel located in the Control Room at rack A2111.

SEARCHER: A person qualified to execute this Procedure, usually the Cyclotron Operator in Charge or another qualified Cyclotron staff member, who will clear, search, and secure the Cyclotron Cave and record the fact in the Operation Logbook.

8.0 REFERENCES

1. LBNL Publication 3000, **Health and Safety Manual**, Chapter 21, Section D (2), *Entry Control Program*.
2. LBNL Publication 3000, **Health and Safety Manual**, Chapter 21, Appendix A, Part E, *Operations and Administration*.
3. LBNL Drawing 8W 6365, *Safety Chain Schematic Diagram*.
4. DOE Order: DOE O 420.2B, *Safety of Accelerator Facilities*

9.0 ATTACHMENT

Attachment A. Cave Search and Secure Checklist. Changes to the checklist do not warrant a revision of the procedure.

Attachment A Cave Search and Secure Checklist

Initial what was completed. ND- Not Done NA- Not Applicable Page _____

Search and Secure Checklist											Date: _____
Preparation	Vault	Pit	Tren	01/02	1	2	3	4	4A	4B	4C
Ask all personel to leave the area	<input type="checkbox"/>										
Search	Vault	Pit	Tren	01/02	1	2	3	4	4A	4B	4C
Enter area closing chain protected doors / gates behind you	<input type="checkbox"/>										
Search and ensure all people are out of the area	<input type="checkbox"/>										
Proceed around the area, press chain inspection lights	<input type="checkbox"/>										
Verify primary (up) & secondary (dn) inspection lights on	<input type="checkbox"/>										
Verify all area doors, hatches and gates are shut	<input type="checkbox"/>										
Verify "Run-Safe" switches are in the "Run" position	<input type="checkbox"/>										
Verify Amber beehive & emergency door open button glows	<input type="checkbox"/>										
Search the area for any unsafe conditions	<input type="checkbox"/>										
Search for any condition that will preclude safe operation	<input type="checkbox"/>										
Verify beam plug shielding is adequate & undisturbed	<input type="checkbox"/>										
Verify shielding bricks are in place in the escape ways.	<input type="checkbox"/>										
Ask experimenter about any temporary shielding.	<input type="checkbox"/>										
Verify beamline devices are working	<input type="checkbox"/>										
Resolve any problems encountered	<input type="checkbox"/>										
After problems are resolved begin SAS again	<input type="checkbox"/>										
Secure	Vault	Pit	Tren	01/02	1	2	3	4	4A	4B	4C
Exit area and close doors / gates behind you	<input type="checkbox"/>										
Return door key to control room	<input type="checkbox"/>										
Record	Vault	Pit	Tren	01/02	1	2	3	4	4A	4B	4C
Record SAS and sign entry in Control Room log book	<input type="checkbox"/>										