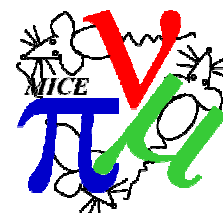


MICE Hall PPS – User’s Guide



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1. Introduction

This document¹ describes the use of the MICE Hall Personnel Protection System (“PPS”). The PPS uses hardware logic and interlocks to track the state of ISIS, the MICE Hall and some experiment subsystems, so as to prevent or limit certain activities during unsuitable situations and therefore ensure the *safety of personnel* in the Hall. Note that the PPS is **not** responsible for the **security** of the Hall, nor for the integrity of **equipment**.

1.1. Overview

Broadly speaking, the PPS can be said to operate at two levels:

- it monitors the integrity of the Hall boundaries and tracks the movement of people in and out by means of the Personnel Keys, and prevents certain operations if people might be exposed
- it monitors the state of the Hall and certain experiment subsystems, and will only provide Permits allowing hazardous activities (such as running beam into the Hall) once the relevant hardware (interlocks) and administrative (Permit Keys) pre-requisites have been met.

The PPS has inputs (such as search buttons and key switches) and outputs (such as indicator lamps) in many locations around the Hall and even outside. The PPS logic is implemented using relay switches, located within the sealed PPS Rack in the Rack Room adjacent to the MLCR. The inputs, outputs and logic state are monitored by interface cards within a pair of VME crates also in that rack, and are converted into a graphical representation by a “PPS Mimic” software application which may be accessed via the computers in the MLCR.



Figure 1.1: RF Cage key and keyswitch in MLCR

¹ Substantive changes since the previous revision of this document are highlighted in yellow.

The PPS system usually tracks the state of entities either with limit or proximity switches for e.g. doors or other moving objects, or by Fortress keys and associated keyswitches (fig. 1.1) – a key in a keyswitch (i.e. inserted *and turned*) confirms a particular state, and it may not be possible to even remove it unless some other condition is satisfied. For example in fig. 1.1, RF Cage Door 2 is known to be locked (else the key could not be in the MLCR keyswitch), but RF Cage Door 1 must be assumed to be unlocked, as its key may be anywhere.

Feedback from the PPS is provided directly by indicator lamps – such as the Hall signs at entrances, fig. 1.2.



Figure 1.2: MICE Hall signs by the auxiliary door

Finally, the PPS has Beam-Off Buttons or “BOBs” in case of emergency, fig. 1.3. A standard BOB will trip off the beam and release all the electromagnetic door-locks to allow escape, while a crash-out button will in addition release the *mechanical* lock only on that particular door.



Figure 1.3: PPS “Beam-Off Button” (left) and door “Break-out” or “Crash-out” button (right); both are commonly referred to as “BOBs”.

To prepare the MICE Hall for data taking, it is first necessary to:

- prepare the PPS system itself, and
- secure the Hall perimeter,

so that the PPS system can track access to the Hall (section 4.2). This requires familiarity with the “PPS Mimic” application (section 4.1).

Next,

- the individual sub-areas within the Hall are searched
- and then the main part of the Hall is searched and secured (section 4.3).

The MICE Hall is now sealed, and the operators may either activate permits for certain operations (section 4.4), or enter the Hall using the Controlled Entry procedure (section 4.6).

1.2. PPS States and Indicator Lamps

Each of the DSA and the Hall can be in one of the following four access states:

- Free access
- Controlled Entry
- No Entry
- Searching

The states of the DSA and the Hall are independent of one another, except that the DSA must be in the No Entry state before the Hall can be searched. The state of the Hall is indicated by four illuminating signs outside the Controlled Entry point (fig. 1.4), one (and only one) of which will be illuminated at all times.

“*Free Access*” means that the Hall is unlocked so that anyone may enter or leave, and no (PPS-controlled) hazards are present.

In the “*Controlled Access*” state the external doors are locked and the PPS will count people in as they enter via the Controlled Entry gate, and count them out again as they leave (see section 4.6). Limited hazards might exist in the Hall.

When the PPS is in the “*No Entry*” state, all entrances are sealed and the MICE Hall is known to be clear of people. Any combination of hazards may be present.

The “*Searching*” state is an intermediate step during the search of the Hall. Although no (PPS-controlled) hazards are present, the external doors are locked and **anyone at the Controlled Entry doors should regard the Searching sign as meaning No Entry.**



Figure 1.4: PPS Indicator Signs at Controlled Entry Doors.
The bottom four indicate the access state.

1.3. General Safety Information

The function of the MICE Hall PPS boils down to enforcing a separation between personnel and those hazards that are controlled by the PPS – radiation (e.g. the muon beam), magnetic fields (the Cooling Channel magnets) and RF.

Bear in mind that

the Hall has plenty of other hazards not under the purview of the PPS!

Standard safety principles – such as wearing correct PPE and knowing where the emergency muster point is – continue to apply as normal.

The separation depends on the correct operation of the PPS hardware and on the human search of the Hall, both of which are fallible! Thus at all times when the PPS believes the Hall to be empty and thus that a hazard may be initiated, the normal white lighting will be replaced by blue lighting. Also, when the Hall is first put into such a state the PPS will first activate the sounders for two minutes. Thus,

if the blue lights come on and/or the sounders go off while you are in the Hall, leave immediately by the nearest exit, pressing the first BOB you encounter en route.

Note also the safety issues associated with the Controlled Entry procedure (section 4.6.1), in particular:

- **keep your Personnel Key on you at all times if issued with one**
- **Door Operator must bring logbook with them if evacuating building**

2. Installation/Cold Starting

The PPS is permanently powered and active (with the exception of scheduled annual maintenance).

If the crates or UPS inside the PPS Rack indicate a failure, seek advice from the PPS Expert (Craig Macwaters).

3. Preparation for Shift

3.1. Warm Start

The PPS is permanently powered and active (with the exception of scheduled annual maintenance).

If the crates or UPS inside the PPS Rack indicate a failure, seek advice from the PPS Expert (Craig Macwaters).

In advance of any running period:

- Confirm that it is possible to access the PPS Mimic screens from the machines in the MLCR (see section 4.1).
- Ensure that the removable tangs from the Crash-Out Button lock assemblies are in place – in particular the one from the Auxiliary Door is usually removed and placed on the adjacent PPS lamps.

3.2. Function Test

- Confirm that the PPS crates are being read out – the “connected” LED will illuminate on each card in sequence.
- Confirm that the data is reaching the PPS Mimic – no error symbols (see fig. 4.1.5) and can see change of state for convenient keyswitch.

4. Running Instructions

4.1. PPS Mimic

4.1.1. Starting the PPS Mimic

The PPS mimic may be accessed from any of the MLCR PCs.

To start the PPS mimic, select the “PPS Mimic Screens” option from the Controls Menu. There will be a pause before the mimic root menu appears; from there select “Other Systems and Equipment”, then “MICE Interlocks” (fig. 4.1.1).

From this MICE-specific menu, select – in order – “MICE Permits”, “Hall PPS Ilks” and “Other PPS Ilks” arranging the resulting windows from right to left across the screen as they appear.

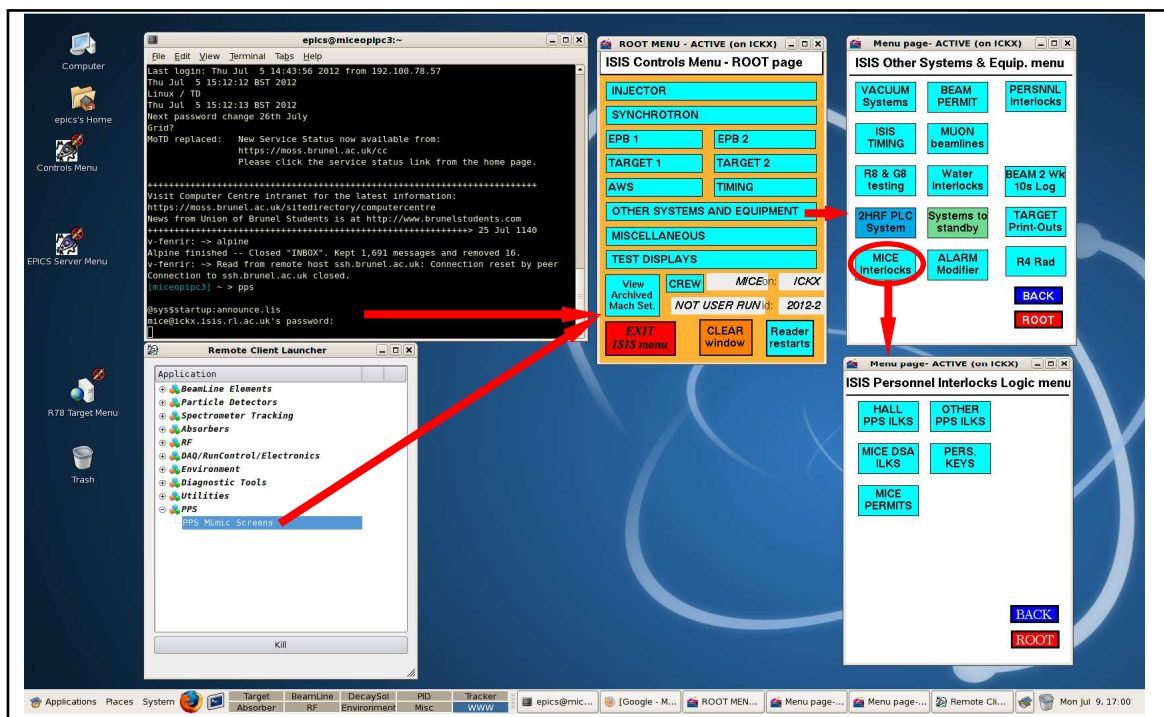


Figure 4.1.1: Starting the PPS Mimic

4.1.2. Understanding and Using the Mimic

The status of the various inputs and conditions within the PPS system is represented as dots that change from red to green as they go into a satisfactory state, with a particular outcome achieved once all the steps along the chain leading into it are satisfied. A few of these outcomes are desired ends in themselves (such as getting a permit) but most are actually inputs to other logic chains.

Getting the PPS permit to run MICE thus boils down to ensuring that all the conditions in each chain are satisfied, working broadly left-to-right across each

window and (if opened as described above) from the left window to that on the right.

For example, the top window (last to be opened) is “Other PPS Ilks” (fig. 4.1.2). The top part of the screen shows two logic chains, for searching the mezzanines. Neither has yet been searched (“RF Mezzanine Searched” and “LH2 Mezzanine Searched” are both red). The mezzanines cannot be searched if a BOB has been pushed, but fortunately this is OK (green) for both mezzanines and thus we are allowed to start the search procedure for the LH₂ Mezzanine (“LH₂ Mezzanine Search Enable” is green).

The RF Mezzanine has a door at each end, and thus cannot be searched until the lower door is closed and locked (since someone might sneak in). This is shown on the mimic as a break in the chain – the “RF Mezz Fire Door Closed” and “RF Mezz Fire Door Keyswitch” inputs are false (red), and thus “RF Mezzanine Search Enable” is unsatisfied.

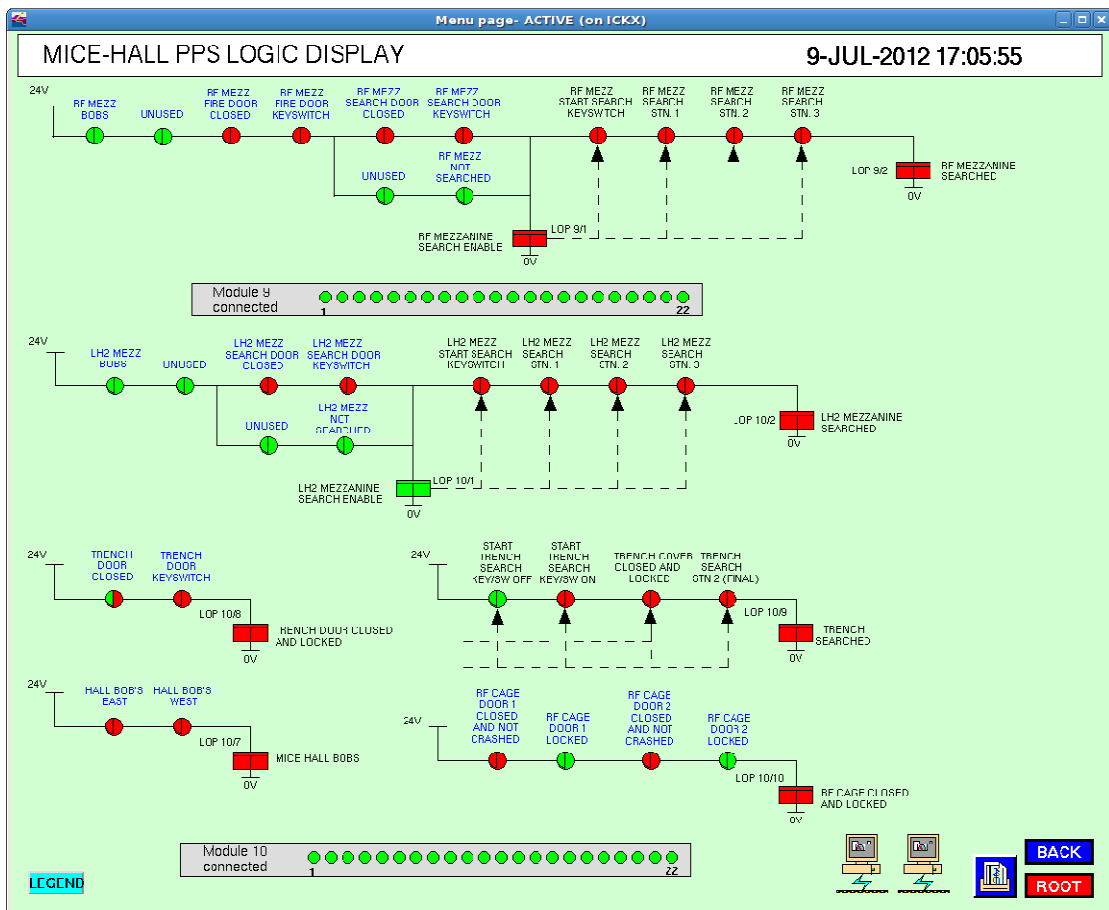


Figure 4.1.2: Other PPS Interlocks

Multiple routes through a chain represent a logical OR between the sets of conditions. Thus, “LH₂ Mezzanine Search Enable” is presently satisfied by the lower path to it (through “LH₂ Mezz Not Searched”, which is true as it hasn’t been). During the search process the LH₂ Mezzanine door will be closed and then locked, at which point the upper path (through “LH₂ Mezz

Search Door Keyswitch”) will also become satisfied. However, completing the search process (getting “LH2 Mezzanine Searched” OK) will break the lower path at “LH2 Mezz Not Searched” *but this doesn’t matter* – the whole chain through to “LH2 Mezzanine Searched” is still satisfied through the upper path. Obviously, someone entering the LH₂ Mezzanine should cause its “searched” status to be lost, and indeed their opening of the door will cause “LH2 Mezz Search Door Closed” to become false and thus break the whole chain.

At the bottom left is a short chain leading leading to “MICE Hall BOBs” which is currently unsatisfied, and we can see that this is because there are *at least* two BOBs triggered (one in each half of the Hall). To get this condition satisfied, it will be necessary to inspect the BOBs and release those that have been pushed, and then press the “Doors and BOBs Reset” button on the Hall Interlocks screen (fig. 4.1.3) to unlatch them. The inputs should then show green, unless a triggered BOB has been missed in which case the process must be repeated.

Again “MICE Hall BOBs” is itself an input to a further chain of logic (“Hall Doors and BOBs”, fig. 4.1.3). Pushing a Hall BOB breaks one of the East/West inputs which breaks “MICE Hall BOBs” which then invalidates “Hall Doors and BOBs”, which in turn drops “Hall Ready” (on fig. 4.1.4)... thus the alert propagates through the logic almost instantaneously to result in the Beam Permit being dropped as desired.

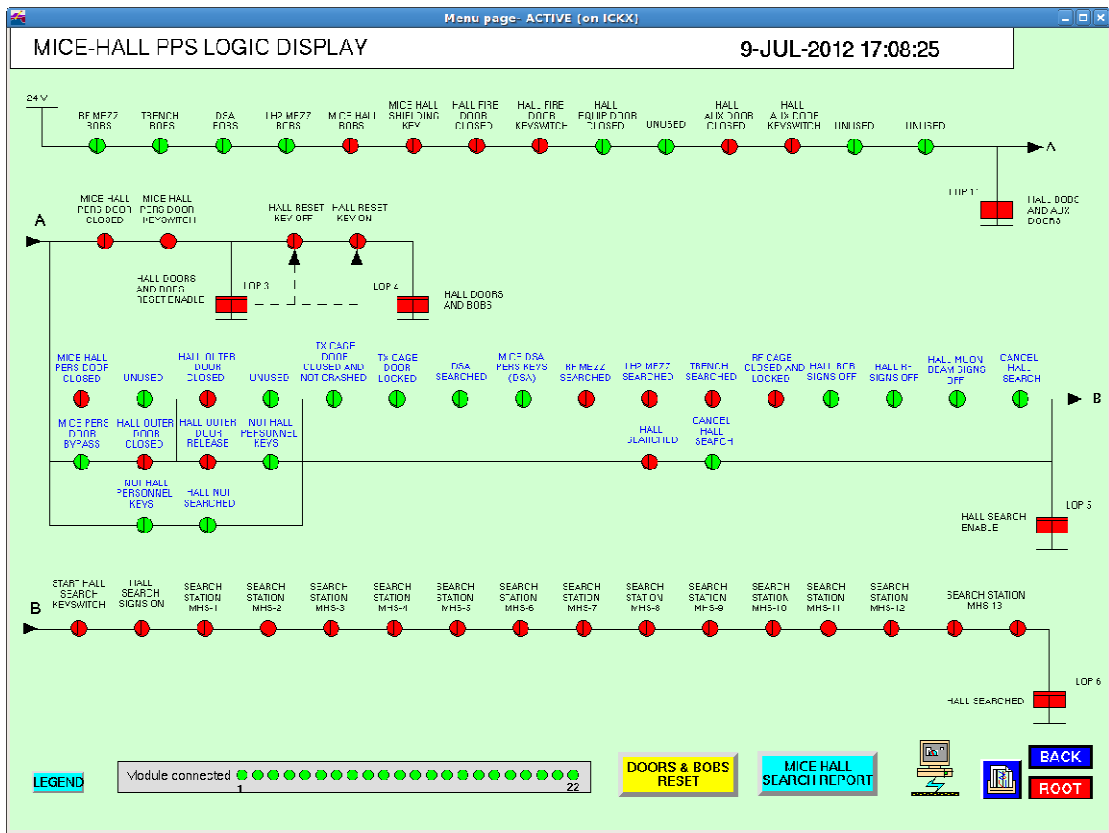


Figure 4.1.3: Hall PPS Interlocks

It mostly doesn’t matter in which order the conditions are actually satisfied along a given chain (so long as at some point they all are, simultaneously) –

for example either of the RF Cage doors (fig. 4.1.2) may be properly closed first – but following the logic in order will usually make it easier to understand.

Note that inputs such as the states of the doors and BOBs are “latching” which means that once the condition is broken they will stay red even if the underlying error is corrected – this allows operators to see what caused the PPS to trip. Once the problem has been identified it is necessary to press the yellow “Doors and BOBs Reset” button (fig. 4.1.3) to release the latch and show the actual state.

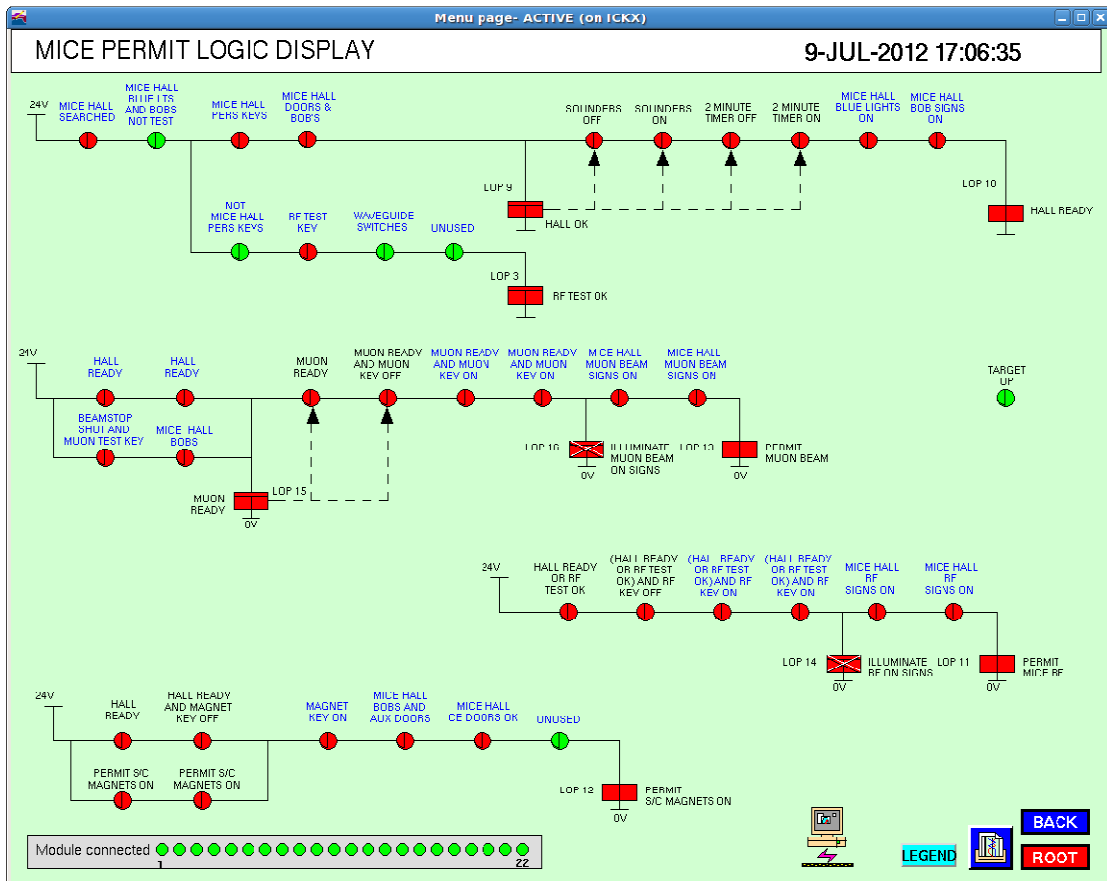


Figure 4.1.4: MICE Permits

Beware also that certain conditions include a logical “NOT”, so that the satisfactory state may actually be one in which the indicated condition is broken rather than satisfied.

All PPS inputs actually have a pair of sensors based on different technologies in case one sensor fails in a false-positive state. Hence in fig. 4.1.2 it can be seen that the PPS is unconvinced as to whether the Trench door has been closed – half of “Trench Door Closed” is green and half red. Either the door is very slightly ajar and needs to be pushed fully closed, or one of the sensors is faulty and needs repair before the Hall can be used for data-taking.

Sometimes communication between the PPS and the mimic fails; in this event the affected items have diagonal marks across them on the display (fig. 4.1.5). This is often caused by a create read-out failure (section 3.2).

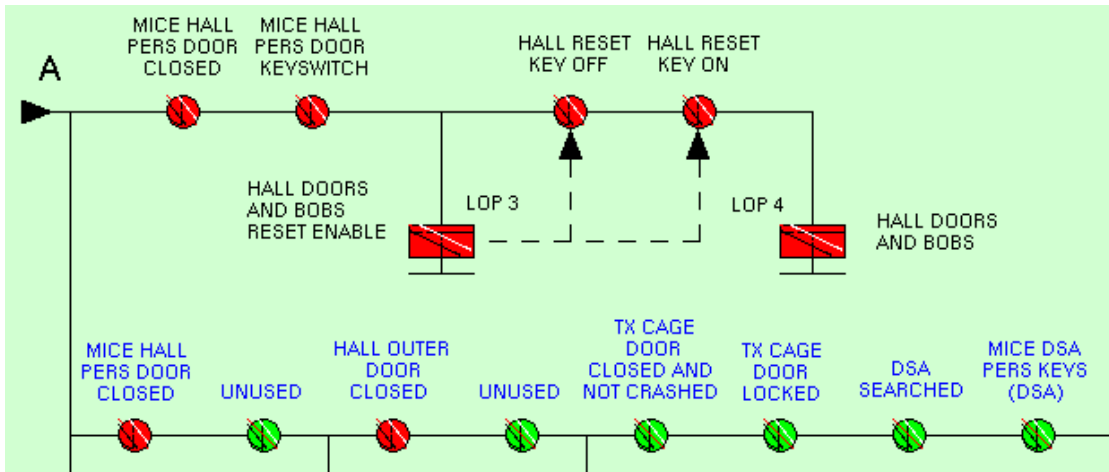


Figure 4.1.5: Communication Issue

4.2. Hall perimeter and pre-requisites

Before the PPS can become active, it must be prepared for use, the various doors to the Hall locked, and certain other checks made.

4.2.1. DSA

The DSA PPS is formally under the control of ISIS. If the DSA has not already been searched and secured, the MOM should request the ISIS DO that it be closed up. Only ISIS crew may search the DSA.

The “DSA Searched” input mimic must be green (fig. 4.1.3 – you may need to press the yellow “Doors & BOBs Reset” button). See also Appendix 1.

4.2.2. “MICE Hall Shielding” key

The MICE Hall Shielding Key must be enabled (inserted into its permit keyswitch and turned) and its input mimic green (fig. 4.1.3 – you may need to press the yellow “Doors & BOBs Reset” button).

Note that this key represents the integrity of the MICE Hall’s passive protection systems such as the magnetic shielding and the PPS meshing. The GLIMOS will remove this key prior to issuing any Permit To Work on such, and only release it once the Permit has been closed out and any consequential actions (such as a ferrous item search) completed.

Removal of PRY (partial return yoke) plates and end caps:

The PRY plates and end caps can only be removed under a Permit To Work that will be issued by the Hall Manager (presently J. Govans). When issued the Hall Manager will withdraw the “MICE Hall shielding” key from the PPS key box in the MLCR¹ thus stopping the ability to run the experiment. The “MICE Hall Shielding” key is only returned to the key box when the work has

¹ Where *only* the PRY’s magnetic shielding is affected, this may be substituted by the SC Permit key.

finished and the area is thoroughly searched for personnel and loose ferrous items and then immediately secured with all the plates and end caps in place.

This key should never be disabled or removed by anyone else. If the Shielding Key is not already enabled when preparing for a shift, you must first find out why it was turned off and *confirm that the work has been completed*.

4.2.3. Padlocked Areas

Access to the cooling channel magnets via the gate on the LH₂ Mezzanine:
The padlock key is held by the MOM in a secure key store outside the MLCR. The key is provided under a Permit To Work that will be issued by the Hall manager (presently J. Govans). When issued the Hall Manager will withdraw a PPS controlled access “personnel key” thus stopping the ability to run the experiment. The personnel key is only returned to the keypress when the work has finished and the area is thoroughly searched for personnel and then immediately secured.

Access behind the south shield wall via the gate on the LH₂ Mezzanine:
The padlock key is held by the MOM in a secure key store outside the MLCR. The key is provided under a Permit To Work that will be issued by the Hall manager (presently J. Govans). When issued the Hall Manager will withdraw a PPS controlled access “personnel key” thus stopping the ability to run the experiment. The personnel key is only returned to the keypress when the work has finished and the area is thoroughly searched for personnel and then immediately secured.

Access to the Crane Access Platform:
The Crane Access Platform is blocked by a mesh barrier to be replaced by a padlocked gate. Any padlock key will be held by the MOM in a secure key store outside the MLCR. The key will only be provided and/or the mesh barrier removed under a Permit To Work that will be issued by the Hall manager (presently J. Govans). When issued the Hall Manager will withdraw a PPS controlled access “personnel key” thus stopping the ability to run the experiment. The personnel key is only returned to the keypress when the work has finished and then immediately secured.

Cooling Channel Access Platform:
After the interior of the PRY has been searched and the magnetic sweep has taken place (if needed), the Access Platform ladder should be blocked by the lockable plate¹. This should be done before the RF and LH₂ mezzanines are searched (4.3.2.2 and 4.3.2.3).

4.2.4. Beamline Access

The Search Paths (section 4.3.1) have been designed based on the premise that the Beamline and Cooling Channel form an impassable barrier along the Hall floor from the moving Beamstop down to the Beam Dump. If any of the magnets or detectors are missing or parked, then a space sufficient for a person to pass may be open. Fencing **must** be erected to block all such gaps.

¹ If the ladder cannot be secured then someone should be posted here until the main Hall search (4.3.3).

4.2.5. Release BOBs

Confirm that none of the BOBs has been left activated (fig. 4.1.3 top left – you may need to press the yellow “Doors & BOBs Reset” button) and release them if necessary. Those in the main part of the Hall are grouped into East and West (fig. 4.1.2).

4.2.5.1. Beam-Off Buttons

Beam-Off buttons are released by pushing gently and twisting the handle clockwise – it will spring back but sit further from the casing (fig. 4.2.1).

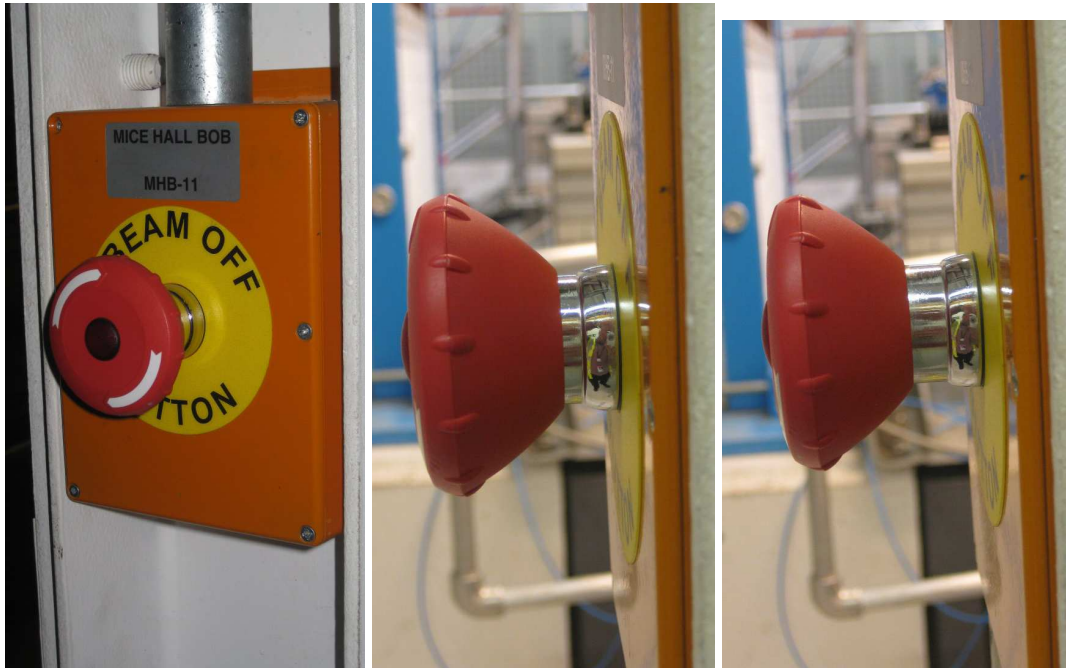


Figure 4.2.1: PPS “Beam-Off Button” (left), depressed (centre), and released (right).

4.2.5.2. Crash-out buttons

Crash-out buttons allow emergency egress from the Hall by rapidly unlocking the door, but they also act as BOBs (fig. 4.2.2).

When a Crash-out is used, the tang that engages with the lock on the door itself is ejected from the button mechanism on the doorframe frame (fig. 4.2.3). Crash-outs are reset by using a thin object to slide the inset tab away from the button, while pushing in the button and simultaneously re-inserting the tang. Again the button will sit out further from the casing.

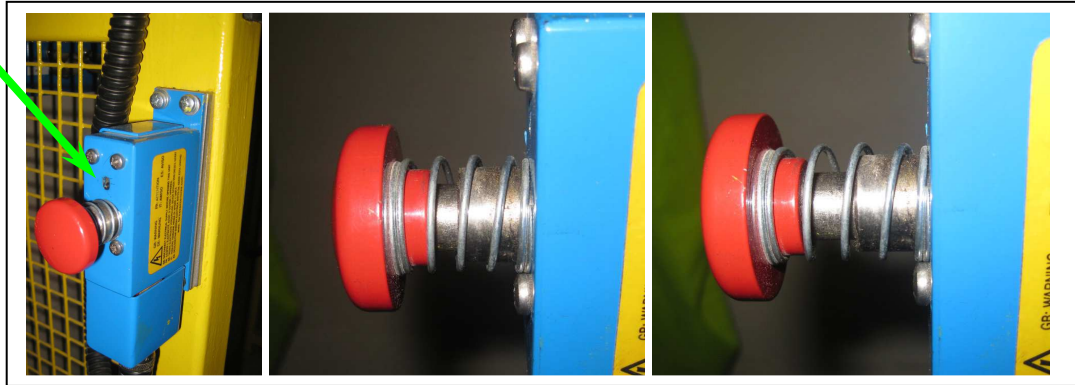


Figure 4.2.2: PPS “Crash-out” button mechanism with reset tab indicated (left); depressed (centre), and released (right).

Note that the tang can be replaced into the button mechanism either way up, but the lock will only operate with it in one orientation. If unsure, it is easiest to try “locking” the loose tang on to the door to make sure it is the correct way up, before replacing it into the frame (fig. 4.2.3).



Figure 4.2.3: PPS “Crash-Out” removable tang.

Confirm everything is in place by trying to pull out the tang by hand – it should be held firmly by the button mechanism.

4.2.5.3. Resetting BOBs

The mimic does not provide details of which specific BOB has been triggered, so a brute-force approach is often needed to ensure all have been reset. BOB locations are shown in fig. 4.2.4.

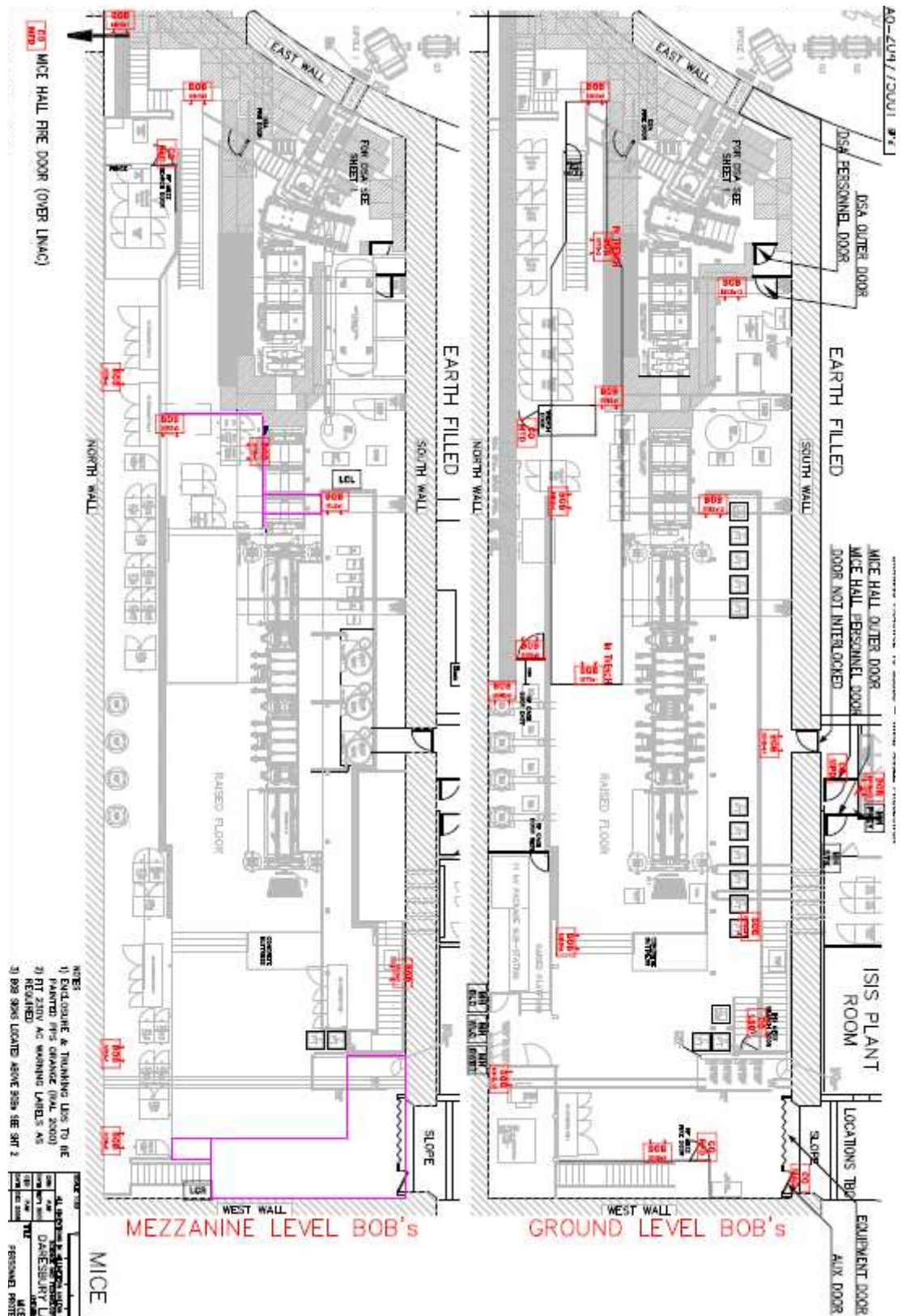


Figure 4.2.4: Indicative BOB locations around the MICE Hall

4.2.6. External Doors

Before the Hall can be searched, the outside doors must be locked to prevent unauthorised entry. “Hall Closed” signs should also be posted at the doors (and taken down after the Hall is re-opened).

4.2.6.1. Closing the Equipment Door

To close the large Equipment Door (“Potterax Door”):

1. Check that the small panel up by the water pipes is in place
2. Pull the door closed, using both bars so that the doorpost stays vertical
3. Push the large lower bolt into the floor
4. Now that the lower end of the doorpost is in place, check the vertical alignment – the contact switches at the top should be just closed, not fully in. Jolt into place with upper pull-bar if needed.
5. Now close the upper large bolt on the inside of the door
6. It should now be possible to close the small shoot-bolt **outside** for the top of the door. It should be fairly easy – do not force it, you may need to turn the door edge beam slightly about its axis.

Refer to fig. 4.2.5.



Figure 4.2.5: Closing the Equipment Door.

“Hall Equip Door Closed” should be green on the PPS Mimic (fig. 4.1.3 – you may need to press the yellow “Doors & BOBs Reset” button).

4.2.6.2. Using the Solenoid Keyswitches

The outside doors to the Hall – the Auxiliary Door and Fire Exit – are provided with solenoid-activated keyswitches, which will not release the door key without permission from the PPS.

When the MICE Hall is in the Free Access state, the indicator on the right-hand side of the lower box will illuminate; holding down the green push-button then allows the key to be turned and removed, to open the door. Otherwise, the button is inactive and the key immobile.



Figure 4.2.6: PPS Solenoid Keyswitch in No Entry state

To lock a door, the door is closed and locked using the Fortress lock on the door itself, and the key is then inserted and turned in as with an ordinary keyswitch. Note that the operator will have to walk back to the MLCR around the outside of the Hall – a fair way from the Fire Exit!

4.2.6.3. Padlocking the External Doors

For certain activities it has been requested that the Hall be secured against unwanted entry, even if the search is dropped.

As this is beyond the scope of the PPS itself, padlocks are provided on the key chains at the Auxiliary Door and Fire Exit. These can be used to shorten the effective length of the chain by looping it back on itself and securing with the lock; the key will not then reach the door even if it can be released from the keyswitch. This secures the Hall without affecting PPS operation or emergency egress.

4.2.7. RF Cage doors and keyswitches

The RF Cage is covered here, as it is not “Searched” in the manner described below. Instead,

- Both doors are closed and locked, and door keys removed
- The keys are operated in their respective keyswitches, located in the MLCR (figs. 1.1 and 4.4.1).

The person(s) performing these actions must ensure that no-one remains in the Cage.

4.2.8. Energise Defence Shields

Make sure that the Light Curtains are turned on.

Successive extensions to the mezzanines have resulted in them now being joined by bridges. Since this would allow people to move from an unsearched mezzanine into a searched one, the boundaries have been fitted with Light Curtains, which project a series of infra-red beams across the walkway and will drop any associated searches should anyone pass through them.

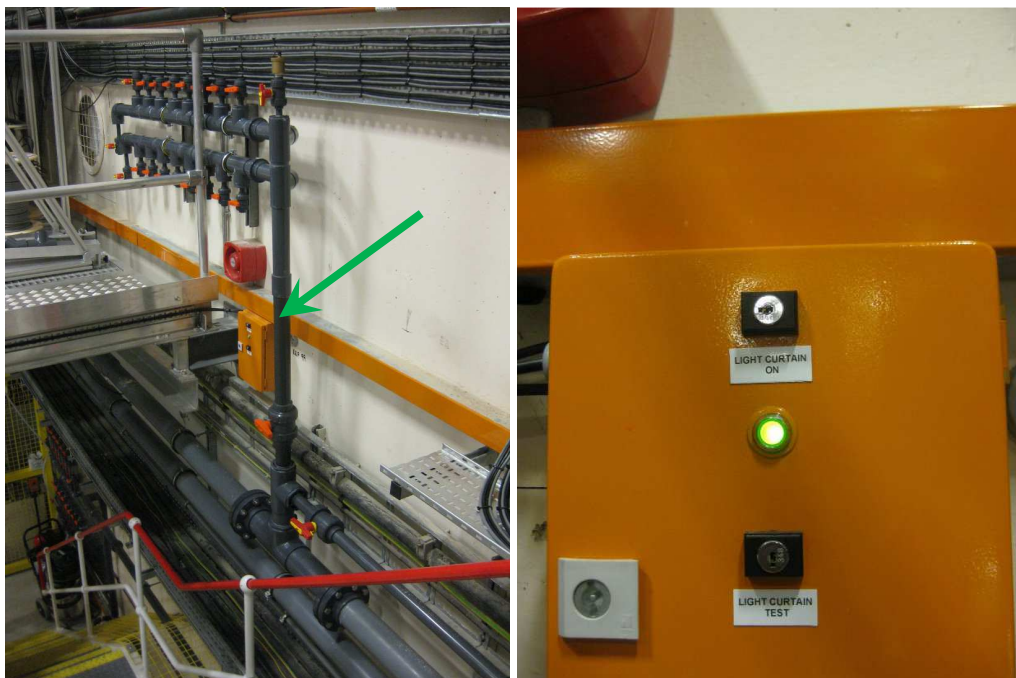


Figure 4.2.7: Control panel for Light Curtains on West Wall, left, and when correctly turned on (note “on” keyswitch is horizontal), right.

There are two control panels, one on the West Wall halfway up the stairs (fig. 4.2.7, *left*) and the other on the railings at the east end of the LH2 mezz. The green lamp on each should be lit (fig. 4.2.7, *right*).

If necessary:

- insert the Start Search key into the “Light Curtain On” keyswitch
- turn clockwise
- remove key, leaving leaving the switch slot horizontal.

If the switch slot is horizontal but the lamp is off, call PPS Expert.

4.2.9. Personnel Keys

Make sure that none of the Personnel Keys is missing from the Personnel Key keypress by the Controlled Entry doors.

4.2.10. PK00 Personnel Master Key

The Personnel Keys Master key (PK00) should be inserted and turned in the Personnel Key keypress by the Controlled Entry doors.

4.2.11. Warning Announcements

The following announcement should be made with the megaphone prior to the Search and Secure (section 4.3):

“Attention, attention! In ... minutes time at ... hours the MICE hall area will be closed in preparation for the search procedure. All personnel must have left the area by this time.”

The following announcement should be made with the megaphone prior to the final search of the main Hall area (section 4.3.3):

“Attention, attention! The MICE hall area is now closed and the search procedure is about to commence. Any personnel remaining in the area must leave immediately via the yellow controlled entry doors.”

The megaphone is normally kept on the West Mezzanine.

4.2.12. Signing-In Books

Finally, check that all workers have left the Hall and signed out.

If so, confirm to the MOM that it is OK to proceed with the Search and Secure (section 4.3).

4.3. Search and Secure

4.3.1. Principles

The basis of the Search procedure is that the searchers go round the Hall following pre-determined paths that have been designed so as to either find or drive out any interlopers. As they go the searchers literally “search” the Hall for anyone that may be working in an unusual or partly-concealed location: as a guide, the search should be as thorough as a game of hide-and-seek, and include inside racks or large boxes. Anyone that avoids being found directly by the search team will instead be driven inexorably out through the Controlled Entry door.

For the MICE Hall the searchers work in pairs. In order to keep the searchers in step – i.e. prevent intruders getting from in front of one to behind the other – the PPS has paired “Search Points” (fig. 4.3.1) at strategic locations. Each Search Point has a button within which are embedded two indicator lamps. When the button – 2B in this case – is pressed, one half lights up locally (fig. 4.3.1, left) and also one half of the corresponding remote button (2A); and conversely when 2A is pressed the other halves light up (centre). Once both searchers are at their Search Point they press their buttons *simultaneously*; the PPS acknowledges this by keeping the buttons lit after they are released (right), and the MICE Hall is deemed searched to those points.

Predictably the search routes go through the Search Points in order (1, 2, 3...); a Search Point will not become active until the one before has been made. The two routes are labelled A and B – thus one searcher will go through Search Points 1A, 2A, 3A, etc. and the other 1B, 2B, 3B, and so on. There must be **NO DEVIATION** from the search path, as this could allow someone to slip past, and searchers **must not swap** between routes A and B.

The search procedure for each area is initiated from its Search Control Panel (SCP) – see fig. 4.3.2. The “Search Enable” lamp will illuminate automatically to indicate that the area may be searched once all the pre-requisites for searching that area have been fulfilled – e.g. the Doors and BOBs of each sub-area are OK, and all the sub-areas of the Hall itself searched. The process commences when the Start Search key is turned momentarily in the “Start Search” keyswitch – this changes the area’s access state to Searching and illuminates the “Search In Progress” lamp on the SCP – and the search team then enter the area and carry out the search itself.

Note that the Start Search key also acts as the Cancel Search key, and should only be made available by the MOM to approved searchers, and returned to the MOM for safekeeping as soon as possible.

If the searchers find someone, find a problem, or are at a Search Point for a full minute without the other end lighting, then they must abandon the search and restart later. Use the Cancel Search key to drop the Searching status for the Hall, or push and release a BOB for a sub-area.



Figure 4.3.1: Search Point Sequence: this button (2B) pressed (left); remote button (2A) pressed (centre); search point made (right).



Figure 4.3.2: Search Control Panel (SCP) for LH2 Mezzanine

4.3.2. Sub-areas

The sub-areas may be searched any amount of time before the main Hall search.

4.3.2.1. Trench

Team B should bring a torch, and check under the raised floor of the Hall at the West end.

The “Start Search” keyswitch (at the East end of the trench) should be operated (turn briefly and then remove key) at the same time as search button 1B, noting:

- the order of operation is unimportant,
- two lamps are provided at each search point to indicate when each is operated.

Close and lock the Trench door, and transfer the door key to the keyswitch (located on the fencing).

Press the “Final Search” button (located on the fencing). This should illuminate.

To cancel the search: remove the door key from the keyswitch.

4.3.2.2. LH2 Mezzanine

Note that the search route for the LH2 Mezzanine passes through the ATEX Zone associated with the Gas Panel for the Liquid Hydrogen system. This zone is demarcated by a pair of chains hung across the mezzanine walkway hooked at the outer (railing) end. Should it be necessary to search the LH2 Mezzanine when there may be Hydrogen present, a Hydrogen system Expert must be consulted beforehand to confirm that it is safe to go on to the mezzanine.

When searching the mezzanine with the Hydrogen system active, the affected Team A should simply remove the chains on their way to the first search point, and **must then replace them on their way out.**

Ensure that the green “Search Enable” indicator is lit on the Search Control Panel (SCP). If not, investigate the cause, using the PPS mimic diagram on the computer.

Using the Start Search key, operate the Start Search keyswitch on the SCP. The “Search In Progress” indicator should light, as will the warning indicators on the light curtains (fig. 4.3.3) showing that they are active.

After this, if either Light Curtain is interrupted, the searches will be reset for *both* mezzanines.



Figure 4.3.3: Light Curtain Active warning indicators

Press the two search buttons 1A and 1B at the same time (this requires two people), noting:

- the order of pressing is unimportant,
- one half of both buttons will light when a single button is pressed; both halves will light when both are pressed, and this indicates that the buttons may be released – after which they will remain lit.

Repeat for buttons 2A and 2B.

Close and lock the door, and transfer the door key to the SCP, and turn it in the keyswitch there. Press the “Search Completion” button on the SCP. This should then illuminate, and the “Search In Progress” indicator go out. To cancel the search: remove the door key from the SCP.

4.3.2.3. RF Mezzanine

This is essentially the same as the LH2 Mezzanine search, except that the “Fire Door” (at the bottom of the west-end steps) must be closed and its key in the keyswitch before the search can be initiated.

4.3.3. MICE Hall

Ensure that the green “Search Enable” indicator is lit on the Search Control Panel (SCP). If not, investigate the cause, using the PPS mimic diagram on the computer.

Using the “Start Search” key, operate the Start Search keyswitch on the SCP. The ‘Search In Progress’ lamp should light on the SCP, as well as the “Searching” sign on the main indicators (fig. 1.4). At this point the PPS will also illuminate the “No Entry” signs and secure the keys in the solenoid keyswitches at the outside doors.

The search team then enters the Hall (closing the Outer Door behind them), still signing the CDM register. Before starting the search itself they must first check all signing-in books to confirm that everyone else has now signed out of the Hall – anyone that has entered since the sub-areas were searched should be asked to leave (via the Controlled Entry doors). After this, if anyone but the search team is encountered in the Hall then the search must be abandoned, the interloper escorted out, and an Incident Report made.

Press the two search buttons 1A and 1B at the same time, noting:

- the order of pressing is unimportant,
- one half of both buttons will light when a single button is pressed; both halves will light when both are pressed, and this indicates that the buttons may be released – after which they will remain lit.

Repeat for button pairs 2A / 2B through to 12A / 12B.

Team A must make a visual check of the RF Cage through the mesh doors, when on points 3 and 5.

Addendum for search with PRY incomplete (e.g. Spring 2016): after point 4, Team B should proceed immediately to point 5 whilst Team A checks inside the PRY at the upstream end, the side, and the downstream end; looking on both sides of and also below the Cooling Channel magnets. Team A should bring a torch.

Historically the Search has taken place without the Cooling Channel magnets present, and thus Team B has had to remember to watch any gap across the beamline whilst waiting for points 5-9. This should now be ameliorated by the pre-requisite that fencing is in place if needed (section 4.2.5).

Team B should bring a torch and must check under the raised floors when going between points 9, 10 and 11.

Sign out of the CDM register.

Close and lock the Personnel Door (the inner door of the “Controlled Entry” pair) and transfer the door key to its keyswitch on the wall. If it is present, remove the Personnel Keys Master key (PK00) from the Personnel Keys keypress, for return to the MLCR. Close the Outer Door.

Press the “Search Completion” button on the SCP. This should then illuminate, the “Search In Progress” indicator and “Searching” sign should go out, and the “Controlled Entry” sign should illuminate.

In the MLCR turn the key PK00 to the ON position – the “Controlled Entry” sign will change to “No Entry”. The PPS is now in the “Hall OK” state (fig. 4.1.4). Return the Start Search key to MOM.

The search team should now print out and sign (legibly) their names on the search report. The report is available via the “MICE Hall Search Report” button on the “MICE Hall Ilks” mimic window; at present it must be printed out in the ISIS MCR itself. A copy of the report is to be filed by the ISIS DO. This step also notifies the ISIS MCR that the two-minute sounders are imminent.

Finally, on the mimic screen for “MICE Hall PPS logic” press the separate yellow button at the bottom called “Doors & BOBs Reset”. Then on the SCP by the Hall Personnel door operate the ‘Doors and BOBs Reset’ keyswitch. This will switch on the blue lights and start the two-minute sounders.

To cancel the search: operate the “Cancel Search” keyswitch in the SCP (using the Cancel Search key).

Note, that if it is enabled the SC Magnets Permit will be maintained and the Controlled Entry mechanism will continue to be enforced (see 4.6.5), i.e. the Hall will be kept sealed. **Thus, the MLCR must be staffed by a PPS-trained shifter at all times that the SC Magnets Permit is enabled.** In this scenario the Controlled Entry mechanism should only be overridden as a last resort, since this will withdraw the SC Magnets Permit and the magnets will do a fast ramp-down or quench. To force the Hall into Free Access, cancel the SC Magnets Permit by turning the permit key (section 4.4) and then cancel the search using the Cancel Search key (as above).

4.4. Permits for Running

The PPS permits are enabled by the action of turning the corresponding key in its keyswitch (fig. 4.4.1), in the PPS permit keypress in the MLCR (fig. 4.4.2).

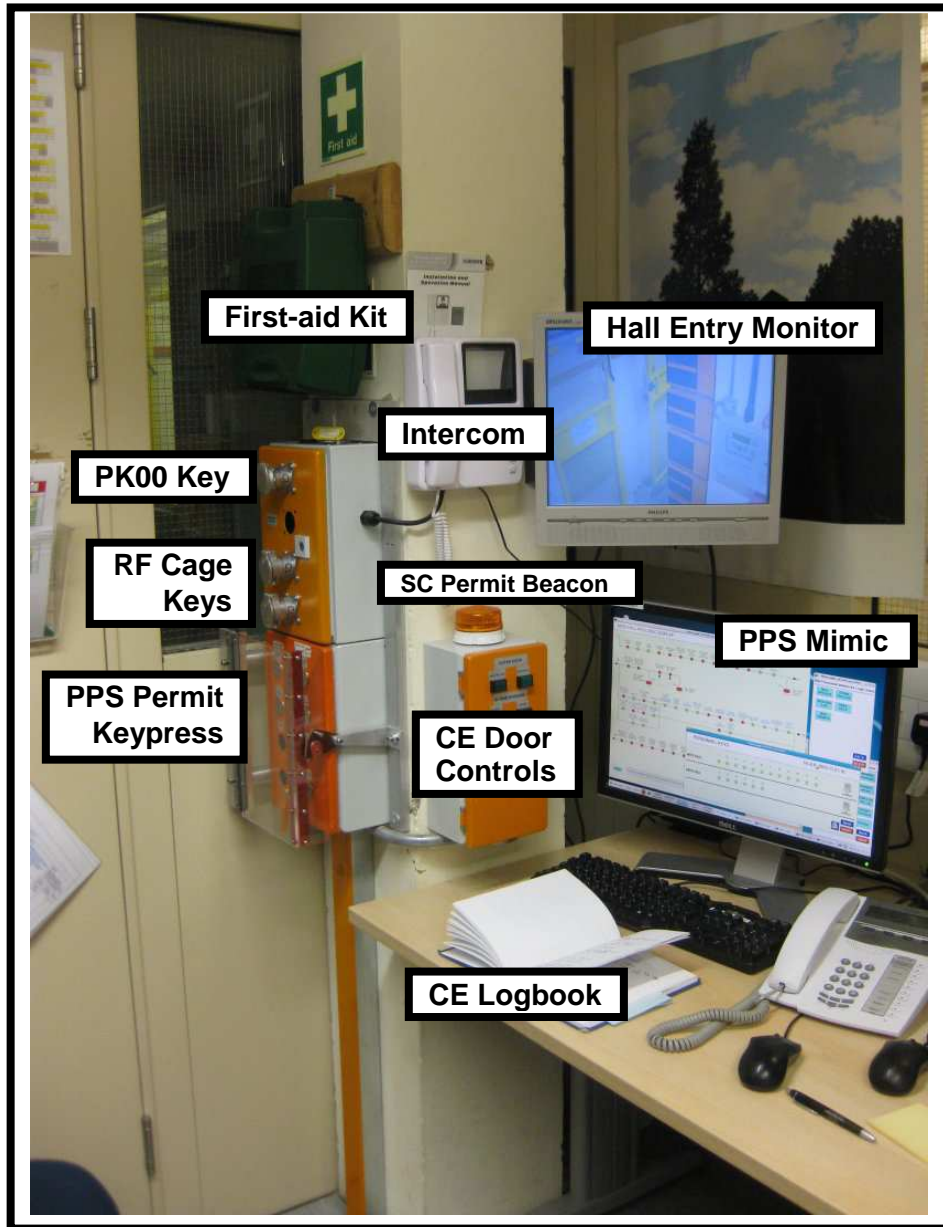


Figure 4.4.1: PPS Controls workstation

If the pre-requisites for a permit are lost – such as the search getting dropped – the PPS will withdraw the permits to prevent the hazard, which may cause damage or undue wear and tear to equipment.

The operator may also withdraw the permit manually, by turning the key back again. It is the operator's responsibility to have turned off dependent equipment beforehand!

Permit keys cannot be removed from the keyswitch while a permit is enabled.



Figure 4.4.2: Permit keyswitches

Require Muon Beam Permit to:

- Have power to the dipoles
- For target frame to be lowered

Muon Beam Permit requires Hall closed and searched (Hall Ready).

Require (superconducting) SC Magnet Permit to

- Energise Cooling Channel magnets

SC Magnet Permit requires Hall closed and searched (Hall Ready) initially, though it can be maintained even if the search is dropped (see section 4.6.5).

Require RF Permit to

- Pulse the RF

RF Permit requires Hall closed and searched (Hall Ready).

The Muon Test key provides for the Muon Beam Permit to be obtained[†] without the Hall closed as long as:

- the beamstop is shut
- all BOBs & crash-outs are OK

This allows **either**

- power to the dipoles, **or**
- the target frame to be lowered

[†] using the Muon Beam Permit key

Note that at the time of writing, *MICE does not have permission to dip the target into ISIS even without the beamline magnets energized nor to run beam into the DSA only, whilst there are people in the Hall.*

The RF Test key provides for the RF Permit to be obtained[†] with authorised people in the Hall (i.e. during a Controlled Entry), as long as:

- RF output is diverted to the dumps (rather than the Cooling Channel cavities).

This key may end up being held by the RF Team Leader when not in use.

The MOM should issue the minimum set of permit keys required for the task in hand.

4.5. What to do if search drops

If the search drops with the MICE target enabled, check immediately that the MICE Target BPS system is OK. In the unlikely event of a BPS error, contact the BLOC immediately – they will guide you through any steps needed to restore **ISIS**’ operations.

On the mimic screen (fig. 4.1.3), look to see what has caused the search to be dropped:

- Controlled Entry doors?
- External Doors?
- BOBs?

Contact the MOM, and investigate and identify the cause, before re-searching Hall as above. Note that it will again be necessary to re-sign the CDM register upon entering the Hall.

One non-obvious (but unlikely) cause is a power glitch in the supply to the blue lighting.

If the search is dropped whilst a Controlled Entry is in progress this should be noted in the Controlled Entry Logbook (see below).

If the search is dropped with the SC Magnet Permit enabled but in a manner where no-one can have entered the Hall, the PPS will keep the Hall sealed and trigger the SC Magnets Search-loss Beacon – see section 4.6.5 for details.

4.6. Controlled Entry Procedure

The Controlled Entry system allows up to 12 people into the MICE Hall without the need to cancel the search. During Controlled Entry a Muon Beam cannot be generated, and the RF cavities cannot be energised. However, the RF system can be operated in Test Mode – when the RF power is diverted to the dump(s). The Superconducting Magnets can remain energised during Controlled Entry; but the fields can only be initiated in the No Entry state.

Each person entering under Controlled Entry conditions must take a “Personnel Key” from the keypress (located between the inner and outer doors of the Controlled Entry point). The procedure is designed to ensure this, but ultimately relies on the integrity of the MICE Operations Team, together with the person entering, not to abuse the system. The importance of the Personnel Key is that it is the entrant’s guarantee that ionising radiation cannot be generated while he/she is in the Hall.

[†] using the RF Permit key

4.6.1. Pre-Requisites and Safety

First you must agree the scope of the work and personnel with the MOM. Prior to the Controlled Entry itself, the Door Operator must know who will be going into the Hall and how long the work is expected to take. This must be agreed for every group going into the Hall – the Door Operator must refuse access to anyone else.

- Before making Controlled Entry, confirm with MOM that it is OK to do so, and that required administrative requirements have been met; and that all entrants have required PPE, film badge, etc.
- A laminated checklist of steps needed is provided in the MLCR for reference.
 - The target must be stopped and frame raised
 - The dipoles D1 and D2 must be ramped to zero current *and* turned off
 - The Beamstop must be closed (one of the entrants must confirm this independently)
 - The Muon Beam Permit and RF Permit should be switched off – this might include extra pre-requisites to those above.
- The Hall environment must be safe: check Neutron Monitor is on and active, ODH Beacon, LH₂ Beacon, etc. (fig. 4.6.1).



Figure 4.6.1: ODH and LH₂ Beacons outside the Outer Door

- A continuous means of communication between the entrants and the MLCR must be in place – e.g. the walkie-talkies provided.
- Ensure sufficient people on hand:
 - must have a *trained operator in the MLCR itself continuously* while CE in progress

- MLCR operator must bring CE Logbook if evacuating building
- at least two people to go in Hall
 - do NOT go past fire door until 2nd person past airlock
 - carry personnel key at all times (do not replace during emergency exit)
 - make sure you know who has the walkie-talkie
 - if untrained personnel are to enter the Hall, they must be guided through the procedure *and accompanied at all times by a PPS-qualified shifter*
 - if SC Magnet Permit is enabled, *all* entrants must have received training on working with magnetic fields
- If a second group is to enter subsequently, their presence must be made known to the first group. The groups must liaise to ensure that the last group to stay in the Hall retains the walkie-talkie.
- If more than one person attempts to enter the CE point “airlock”, the MLCR operator **MUST** release the button to drop the search.
- **Personnel with pacemakers may not enter.**
- Entrants are advised against bringing in unneeded ferro-magnetic objects or magnetically sensitive materials such as credit cards, *etc.*
- Experts wishing to bring specified ferrous tools or equipment beyond the 5 Gauss Line around the Cooling Channel *must provide copies of a written risk assessment & method statement* agreed with the GLIMOS (Andy Nichols). **No ferro-magnetic material is allowed on the LH₂ (South) Mezzanine.**

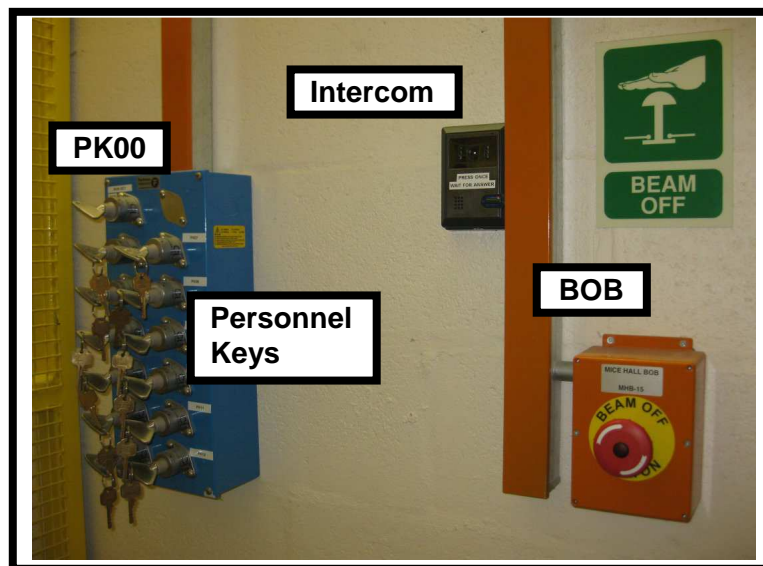


Figure 4.6.2 Personnel Keys Keypress inside the Controlled Entry point.

4.6.2. Going In

The first person to enter should also take the Personnel Keys Master key (PK00) from the MLCR, for insertion into the Personnel Keys keypress (fig. 4.6.2). Upon removing PK00 from the MLCR keyswitch, the indicator lamps (fig. 1.4) will change to “Controlled Entry”.

The entrant then approaches the Outer Door and signals the MLCR Operator, e.g. by waving at the camera for the Hall Entry monitor. The Door Operator releases the Outer Door using the ‘release’ push-button in the MLCR – this must remain pressed while the Outer Door is open, in order not to cancel the search. A “Door Open” indicator near to the release push-button illuminates while the door is open (fig. 4.6.3).

The operator must ensure that only one person enters while the door is released. If a second person ‘tail-gates’, the operator must release the push-button immediately to cancel the search.

When the Outer Door is released the indicator above it changes from red to green. The entrant should close the door behind him/her. Once the door is closed, the “Door Open” indicator will go out and the Door Operator may release the push-button.

The first person should insert and turn PK00 in the Personnel Keys keyswitch, where its operation will mechanically release the 12 Personnel Keys, and also remove the Personnel Door key from its keyswitch and use it to unlock the Personnel Door’s Fortress lock. The Fortress lock should then remain unlocked until all entrants have left the Hall.

The entrant should take a Personnel Key and then contact the MLCR operator on the intercom (press button and wait for response, like a door-bell). The Door Operator should record in the Controlled Entry logbook:

- the entrant’s name
- Personnel Key number
- the time and date of entry
- the Door Operator’s own initials
- the name of the entrant certifying the Beamstop is closed.

The entrant should then use the Union key attached to their Personnel key to open the Personnel (inner) Door, taking the Personnel Key with him/her in e.g. their pocket. Once inside, close the Personnel Door and **check** it is properly closed.

The entrant does NOT need to sign in using the CDM register*.

(Note: The Personnel Door’s entrance indicator will be green, and its magnetic lock will be released, only if the Outer Door is closed.) When the red indicator is illuminated the door is held closed by a magnetic lock. The magnetic locks and red/green indicators are only active when the Hall has been searched.

While in the Hall it is OK to enter any of the sub-areas – simply remove the door key from the relevant keyswitch (dropping the local sub-area search in the process). The sub-areas **do not** need to be re-searched during the Controlled Entry – they will only need to be re-searched should the Hall search need to be repeated, e.g. if it is dropped.

* i.e. the entrant is always signed into the Hall, but only ever by one register at a time.

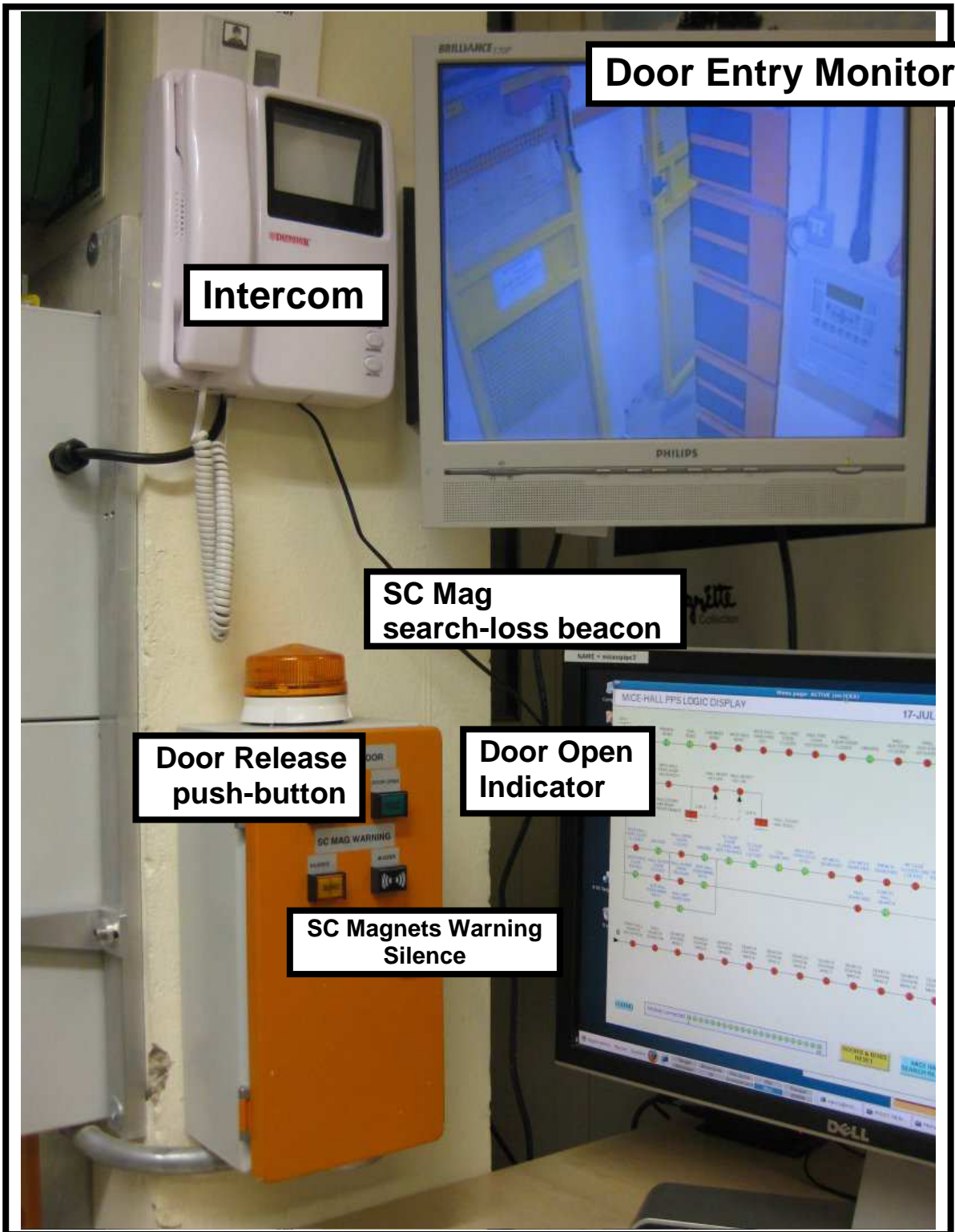


Figure 4.6.3: Controlled Entry controls

4.6.3. Coming Out

- The Personnel Door's Union lock is opened from the inside by a lever. Close the door behind you.
- Return your Personnel Key to its place in the keypress.
- Use the intercom to alert the MLCR Operator of your desire to exit,
- The operator releases the Outer Door, maintaining the release push-button until the door has been closed.
- The MLCR operator should record the time of exit in the Controlled Entry logbook.
- The last person to leave must lock the Personnel Door's Fortress lock and return its key to the keyswitch, and remove PK00 from the Personnel Keys keyswitch and bring it back to the MLCR.

4.6.4. Returning to normal operation after Controlled Entry

The Fortress lock on the Personnel Door must be locked, and its key returned to the nearby keyswitch.

The Personnel Keys Master key (PK00) should be returned to its keyswitch in the MLCR. Note that the Master key cannot be removed until all Personnel Keys are in place.

Close out the logbook entry and check that all tools, walkie-talkies etc. have been brought out of the Hall.

Press the yellow "Doors & BOBs Reset" button on the mimic, then operate the 'Doors and BOBs Reset' keyswitch, on the Hall SCP. This will trigger the two-minute sounders, so it is polite to warn ISIS first.

4.6.5. CE and SC Permit

If the Superconducting Magnets Permit is on when the Hall search is cancelled in a manner whereby the Controlled Entry state can be maintained, then it and the SC Magnets Permit are maintained. (Despite the Controlled Entry access state being maintained, the Hall is nevertheless "unsearched", and therefore the Muon Beam and RF Permits will be cancelled.)

Under these conditions the SC Magnets Search-loss Beacon will flash and the SC Magnets Warning buzzer sound – the sounder can be muted by pressing and holding the "Silence" button (fig. 4.6.3).

It is possible to re-search the Hall without losing the SC Magnets Permit, by sending in the searchers in a Controlled Entry.

5. End of Shift

At the end of a shift you would normally leave the Hall overnight in the “Hall OK” or “Hall Ready” state (Hall secured and the “No Entry” lamps illuminated).

Release all Permits and return all Permit keys and the Doors And BOBs Reset key to MOM to be locked away.

(Leave “Cancel Search” key with attached Personnel Door Yale key with ISIS DO for emergency access.)

As equipment is often left in a remotely-operable state, the MLCR should be locked if left unattended. This also prevents unauthorised access.

6. Shutdown

The PPS is permanently powered and active (with the exception of scheduled annual maintenance).

At the end of a data-taking period:

- Release all Permits and return all Permit keys to MOM to be locked away.
- Put the Hall into Free Access – use Cancel Search key, then Yale key to open Controlled Entry doors.
- Return Start Search key and Doors And BOBs Reset key to MOM to be locked away.
- Unlock and open sub-area and external doors (Auxiliary Door).
- Open doors to RF cage.

7. Emergency Shutdown

The PPS is permanently powered and active (with the exception of scheduled annual maintenance).

If the crates or UPS inside the PPS Rack indicate a failure, seek advice from the PPS Expert (Craig Macwaters) or ISIS crew.

8. Troubleshooting

Press the “Doors and Bobs Reset” on the mimic, then turn the Reset key.
Then seek advice from the PPS Expert (Craig Macwaters) or BLOC.

To start the PPS Mimic from the command line on any Thin Client PC, use the pre-existing SSH keys:

```
ssh -XY -i .ssh/PPSkey mice@ickx.isis.rl.ac.uk '@con_com:isis'
```

This command should already be set up as a shell alias, “pps”.

If stripy lines appear across items on the Mimic (fig. 4.1.5) indicating a communications issue, check crate read-out (section 3.2) and contact the PPS expert.

When turning on the Light Curtains, if the “Light Curtain On” switch slot is horizontal but the green lamp is off, call PPS Expert. Don’t mess about with the Test mode!

If very strange things happen after the main Hall search is completed, when attempting to change state from “Hall OK” to “Hall Ready” (sounders continue for more than two minutes, indicator lamps flicker, relays continuously active in PPS Rack), then the PPS expert or BLOC should check that the Test Select Switch is set to Blue/White lights, **NOT** BOBs, and seek advice from the PPS expert.

Roles/Experts:

MICE PPS Expert: Craig Macwaters (RAL)

MICE PPS Engineer: Phil Warburton (DL)

ISIS PPS Expert: Mark Arnold

9. Documented Procedures

The PPS must undergo an annual Functional Test.

Appendix 1 – DSA Access

The DSA is formally part of the ISIS synchrotron. No access is possible while ISIS is running. When ISIS is off, it is possible to request access to the DSA via the ISIS DO.

When the **ISIS Beam** is on,

- The DSA blue lights will be on
- “Beam On” appears on the sign by the DSA entrance (fig. A1.1)
- The “Beam On” lamp illuminates over the DSA fire exit (Fig. A1.2)

Usually, DSA access is granted by dropping the DSA search completely. ISIS crew will then need to re-search the DSA before either ISIS or MICE can run.

Alternatively it is possible to make a Controlled Entry into the DSA – the procedure is given below.

Note that at time of writing, the Local Rules formally require a Radiation Survey when opening up the DSA for the first time after a User Run.

As a matter of courtesy it is expected that the MICE Hall Manager and MOM will be informed whenever the DSA is secured or opened up, whether by dropping the search or putting into Controlled Entry mode.

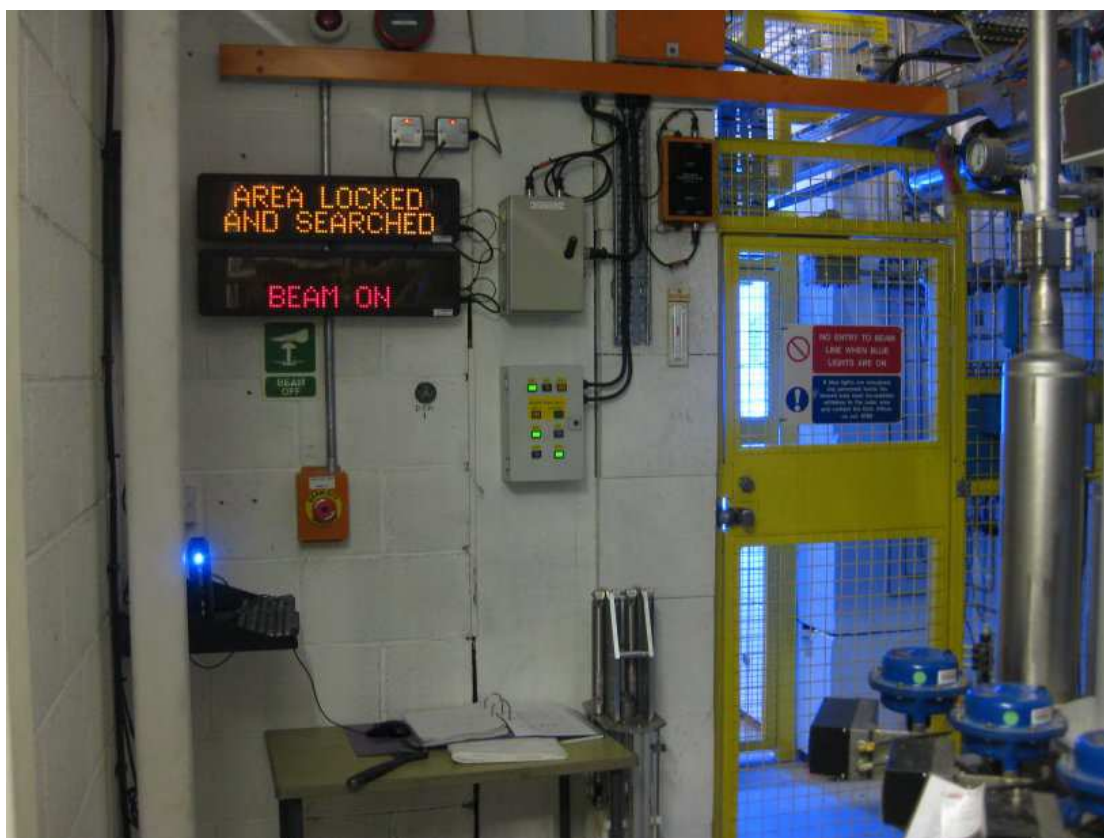


Figure A1.1: DSA Entry Doors



Figure A1.2: DSA Fire Door

Draft DSA Controlled Entry Procedure – Nov. 2013

The following protocol allows Controlled Entries of up to five persons into the DSA at any one time.

(Note that PK06 isn't really a Personnel Key and thus has no other key attached – it is dedicated to the door release feature and so has been labelled “RemEnbl” for clarity.)

Explicit permission must be obtained from both the ISIS DO and the MOM to put the DSA into the Controlled Entry state.

The procedures below that put the DSA into the access state allowing Controlled Entries, and then to return the DSA to a fully secured state, *are to be carried out by a member of the ISIS crew.*

Putting DSA into Controlled Entry state (ISIS crew)

Requires: “MICE DSA Door - ISIS MCR” Fortress key
 “DSA Personnel Master PK00” Fortress key
 Union key for “MICE DSA Outer Gate”
 walkie-talkie

} all from
 ISIS MCR

- 1) Use key exchange next to DSA Outer Door to release “MICE DSA Door” Fortress key; unlock Outer Door with this and the Yale key
- 2) Enter airlock, and close Outer Door firmly.
- 3) Insert PK00 Master key into keyswitch at top left of keypress.
- 4) Transfer Personnel Key PK06 (RemEnbl) to “Enable Remote Door Release” keyswitch at bottom right.
- 5) Leave walkie-talkie on top of keypress.
- 6) Exit airlock into Hall, closing door firmly. Confirm that both magnetic locks (above outer and inner doors) show green.
- 7) (Check that remote unlocking from MCR is working)
- 8) Return Union key to MCR.

Returning DSA to fully closed state (ISIS crew)

Requires: DSA “Doors and BOBs Reset” key (in keybox in MICE Rack Room)

- 1) Use phone outside DSA (beneath mimic screen) to contact MCR and request entry.
- 2) Confirm keys # 1-5 all present.
- 3) Transfer RemEnbl key from “Enable Remote Door Release” to Personnel Key PK06 keyswitch just above.
- 4) Remove DSA PK00 Master key (top left).
- 5) Collect walkie-talkie from top of keypress.
- 6) Leave airlock, closing door firmly. Confirm that both magnetic locks (above outer and inner doors) show green.
- 7) Close the Outer Door and remove “MICE DSA Door” Fortress key
- 8) Retrieve “MICE DSA Door - ISIS MCR” from key exchange.
- 9) Insert and turn “Doors and BOBs Reset” key - Doors and BOBs lamp on SCP should illuminate.
- 10) Return “Doors and BOBs Reset” key to keybox, and PK00 and “MICE DSA Door - ISIS MCR” keys to MCR.

Entry and Exit

Search is maintained as long as only one airlock door is ever open at a time. They are interlocked using magnetic locks - so you **MUST** ensure they are properly closed, otherwise the other door will be inoperable without dropping the search!

It is the responsibility of the **last** person to use the doors, to make sure they are ready for the *next* person.

Entry

- 1) Use phone outside DSA (beneath mimic screen) to contact ISIS MCR (x.6789) and request entry, replace phone.
- 2) Outer Door will be released remotely - enter airlock, closing door firmly.
- 3) Take a Personnel Key (# 1-5).
- 4) Use walkie-talkie to contact ISIS MCR - provide name and key number to be recorded in ISIS' logbook.
- 5) Enter DSA, closing Personnel Door firmly. Confirm that both magnetic locks (above outer and inner doors) show green.

Exit

- 1) Enter airlock, closing Personnel Door firmly.
- 2) Use walkie-talkie to contact ISIS MCR - provide name and key number for exit to be recorded in ISIS' logbook.
- 3) Replace Personnel Key.
- 4) Leave through Outer Door using Union latch, closing door firmly. Confirm that both magnetic locks (above outer and inner doors) show green.

Appendix 2 – DSA Roof (BLOC)

The mesh sections comprising the DSA roof are secured with Fortress locks to prevent ISIS operation without a complete roof over the DSA. The corresponding keys are held in a solenoid-keyswitch in the DSA (fig. A2.1).



Figure A2.1: DSA Roof Keyswitch

Releasing DSA roof panels

- Confirm with ISIS, and have them drop DSA search
- Turn rotary switch to “OFF” – this will release keys
- Take appropriate keys, and unlock desired panel – it can then be craned away
- The keys will remain trapped on roof until panel is replaced

Replacing DSA roof panels

- Replace and lock panel in position
- Insert keys in keyswitch
- Once all panels (keys) have been replaced, the rotary switch can be turned to “ON”
- “DSA Roof Panels Locked” should be green on “DSA Interlocks” mimic screen (fig. A2.2 – ISIS may need to press the yellow “Doors & BOBs Reset” button on their separate version of the DSA interlocks mimic).

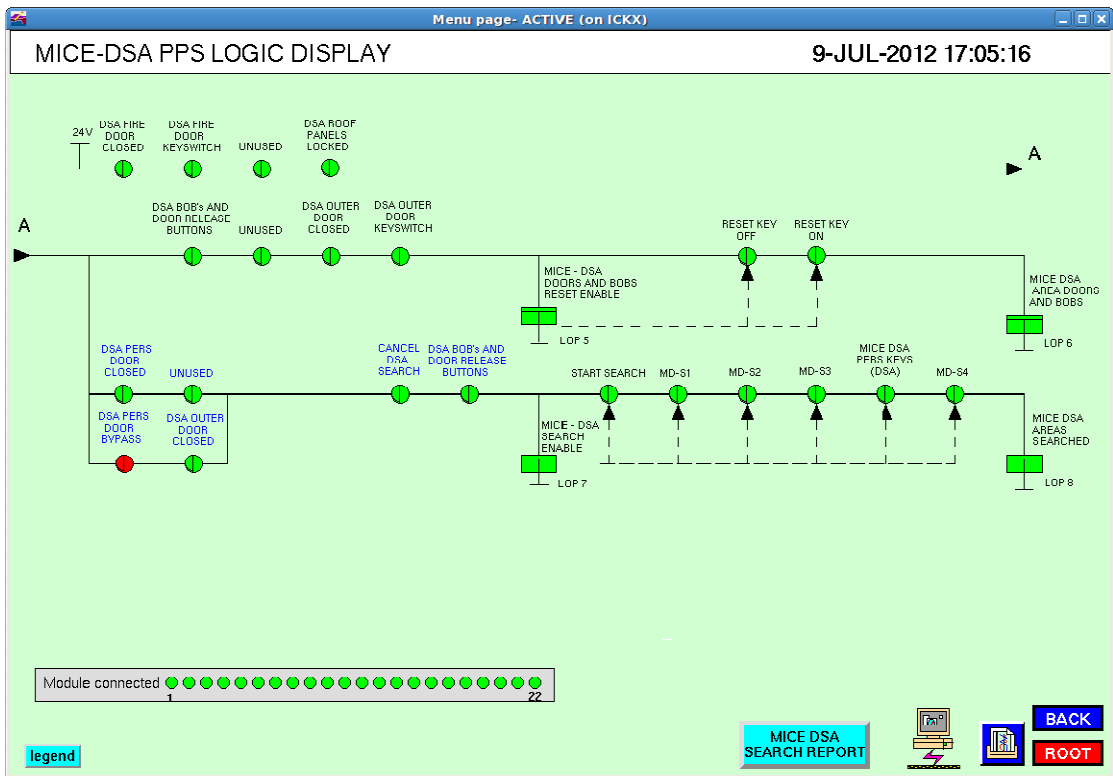


Figure A2.2: DSA Interlocks mimic screen