

Minutes of Radiation Safety Committee of December 5, 2000

Modifications to the RHIC Interlock to prevent High Intensity Protons into AtR

Present: L. Ahrens, W. MacKay, R. Karol, N. Williams, J. Sandberg, P. Ingrassia, A. Stevens, A. Etkin, J.W. Glenn, and D. Beavis

Motivation: The scheduled running program for FY2001-FY2002 has high intensity protons being used by various users in between the times required to fill RHIC. It is desired that the change from RHIC injection to the other programs could be done in less than 15 minutes with a desired switching time of about 1 minute.

The interlocks presently allow AtR to be on if the LEPT beam stops are closed, i.e. only ions being injected. The operations next year require the ability to switch from polarized protons to RHIC to High intensity protons to other users. Therefore, the present interlock requires modification. J.W. Glenn presented a proposal to the committee. (See attachment 1)

The committee approved the overall plan but there were some details to be worked out by a sub-committee.

The logic presented and the inputs to the logic were done in a redundant fashion. Most members were of the opinion that this was not necessary. The RSC sub-committee will make a determination if these interlocks need to be dual or single. **(CK-FY2001-RHIC-197)**

The logic relies on the relay system knowing which source is being used to generate the beam in the LINAC. A valve has been added between the high intensity proton source and the RFQ. If this valve is closed then only the polarized proton source can provide beam for the RFQ. The committee approves the use of this device provided it and its attached interlocks can meet the appropriate standards for being in the interlock system. This device defines the high intensity source is off.

A mechanical review of this device must be performed and an approval memo by the Chief Mech. Engineer (CME) sent to the RSC chair. **(CK-FY2001-RHIC-198)**

An electrical review of this device must be performed and an approval memo by the Chief Electrical Engineer (CEE) sent to the RSC Chair. **(CK-FY2001-RHIC-199)**

An appropriate reachback device must be reviewed and approved by the CEE or waived by the RSC chair. **(CK-FY2001-RHIC-200)**

Interlocking the power supply for the solenoid was proposed as the second device if needed. This solenoid is only used for the high intensity proton operation. If it is off the intensity is expected to be approximately a factor of 100 lower. This was approved provided:

- 1) A study is conducted to verify the reduction in intensity. **(CK-FY2001-RHIC-201).**
- 2) An engineering review be conducted and an approval memo sent to the RSC chair. **(CK-FY2001-RHIC-202)**
- 3) An appropriate reachback should be included or signed off by the RSC chair that it was not necessary. **(CK-FY2001-RHIC-203)**

If only one device is needed the committee prefers using the valve.

LEPT beam stop 1 (BS1) is in the beam transport before any bend into the Booster. This prevents beam from being transported into the HEBT area for momentum measurements or polarization measurements while ions are being injected to RHIC. A key switch (at the LINAC) allows DH1 to substitute for LEPT1. It was proposed to have this key switch moved to MCR so the operations could make this device substitution more easily and that DH1 off be included in the interlock logic which defines high intensity protons off. This was approved.

A procedure giving guidance to the operators must exist for the use of this device substitution switch. **(CK-FY2001-RHIC-204)**

The proposed logic allows the 8 and 20 degree bends to be on if ions or polarized protons are being injected into the booster. With High intensity protons being injected into the Booster, the logic requires an energy miss-match in the AtR transport to prevent protons from entering the W-Line. The energy match-match requires the 4-degree bend to be operating at current equivalent to a minimum energy, such as 20 GeV/c, and the 8 and 20 degree bends to be operating with currents corresponding to currents equivalent to a maximum energy, such as 4 GeV/c. This logic allows high intensity protons to the V target station without them being transportable to the W Line. Several member of the committee had a strong preference for an off status rather than current limits on several dipoles. It is noted that this type of energy match-match logic is already in use when there are no other alternatives. The idea of a minimum current was that it would save cycling the PS contactor and the operating field would be easier to reproduce. It is not clear to the committee that these steps are needed and the off status is considered safer than the current limit. This issue needs to be resolved by further review. **(CK-FY2001_RHIC-205)**

The discussed interlocks provide a method to determine which source is being used at the LINAC. The polarized proton source may still be too intense to allow for injection to RHIC without other conditions. A review is needed to determine the sufficient conditions to allow the polarized proton source to inject RHIC. **(CK-FY2001-RHIC-206)**

Attachments:

1) J. W. Glenn to RSC

*Attachment 1
RSC min. 12/5/00*

Anderson, William E, 09:29 AM 12/5/00 , "U" line supplies

Received: by exchange01.bnl.gov
id <01C05EC7.D6AF2800@exchange01.bnl.gov>; Tue, 5 Dec 2000 09:29:55 -0500
Message-ID: <1416500507ADD4119E970002B30A363E63B9C6@exchange01.bnl.gov>
From: "Anderson, William E" <wanderson@bnl.gov>
To: "Glenn, Joseph W" <jglenn@bnl.gov>
Subject: "U" line supplies
Date: Tue, 5 Dec 2000 09:29:55 -0500
MIME-Version: 1.0
Content-Type: text/plain;
charset="iso-8859-1"

Woody,

UD1-2 has an AK50 breaker in the supply, but security group has had us put in a contactor on the line 480 vac line before it gets into the power supply. This contactor is interlocked thru the security system to shutdown all the 480 vac to the supply if required. When this happens there is still 110 vac to the control circuits and ps interlocks.

UD3-6 has a standard molded case breaker.

Any other questions just give me a call.

Bill

Injectors System Coordinators' Meeting, 13Nov00 L Ahrens

Attending: Todd Satogata (who is also the Scheduling Physicist!), Kip Gardner, S.Y. Zhang, Derek Lowenstein, John Benjamin, Dannie Steski, Thomas Roser, Willem van Asselt, Nick Tsoupas, Keith Zeno, Peter Ingrassia, Paul Sampson, Chris Naylor, John Ryan, Woody Glenn, Kevin Brown, Gary Smith, Dejan Trbojevic, Leif Ahrens

Today's somewhat ad hoc agenda is first to learn what we can about the proton requirements in January, and second to step through the topics and speakers for the RHIC retreat injector section (Friday, Stony Brook).

Nick updates us on the plan in the U line, downstream section. This is proton radiography work. Nick has spoken with Phil Pile, and will speak with George Green, who functions as liaison with the Los Alamos experimenters, this week. The proton energy will be the nominal 24 GeV and the intensity will be a single bunch of 2×10^{11} per AGS cycle. This intensity limit is apparently a safety envelope constraint for beam transported beyond the eight-degree magnet in the U line.

The other proton running on the schedule for January is fast extraction via the slow beam switchyard to the C1 line. Kevin Brown speaks for this. He is planning to talk to Jerry Hastings this week about the detailed experimental needs. This is SNS target work; 24 GeV and 3 GeV(?). Most of the effort is toward developing the setup, though there is one experiment included.

Kip's topic for the retreat is context switching, which here

means the switching (in less than 15 minutes) between gold for RHIC and high intensity protons (e.g. for g-2).

He will give the status. We (Ted, John, Kip, and Leif) have not yet met to discuss the software, the "sequencer", for doing the context switch. But in this regard Woody introduces some additional information. He is moving (the RSC committee) toward a reconfiguration of the implementation of the critical devices for AtR. Instead of simply turning the magnets off (clean logically but less so for operations since we soon want to get the magnet back to the original field) the current in the magnets will only be required to be less than some value. Adequately robust hardware to enforce this sort of rule exists. Woody mentions this since there will have to be an understanding for where the Radiation Safety piece of the context switch lives. Perhaps at some point in the "sequence" the software informs Operations that now is the time to close or open a beam stop?

Woody speaks on AtR jitter Friday. He is collecting data from the RHIC run. He will include our experience with chasing the beam revolution frequency in RHIC at injection. This subject is not closed – as to which piece in the dance was responsible for the significant changes measured.

On Friday Dannie will give a brief overview of the Tandem before describing the present Tandem beam status (last run), and possible future improvements. Today he has some new information and pictures from the chopping experiment at Tandem. While last week we learned from John of the success chopping at the high-energy side of the Tandem, today we learn

of the similar measurement at the low energy side. With a 500 ns wide pulse from the high voltage modulator, the beam is removed in about 500 ns when pulsed (4kV) at the low energy side upstream of the Tandem and perhaps in 200 ns (and with just 2kV) at the high energy end. This degradation in the sharpness of the transition at the low energy end is explained by the slow transit time of the ions through the plates. So this is good information to have – where we could go and what to expect. Dannie will move toward buying the necessary high voltage modulator for the high energy chopping.

Nick will speak to AtR emittance extraction from measurements done last run in that line. There was plenty of interest around the room; and clearly there is overlap between this subject and Woody's jitter subject. Todd asked if emittance measurement in AtR is part of Operations' morning numbers measurements. Woody says the procedure is there, but is not yet exercised. Dejan claims we have badly aligned quads in AtR. Woody asks for details off line. I believe Nick's only concern as far as the line model is associated with measurements of the dispersion function. Kevin asks if there is confusion as to the definition of this function.

Dejan notes that we lost shifts during the last run due to failures associated with the AtR transformer readings – which are inputs required to prove that we are living within our radiation safety envelope. This is true. Although our envelope has now in several dimensions expanding with our new RHIC "operating license", we still will need to be able to prove that we are inside. So the transformers need to be reliable enough not to cost us down time. What the enlarged envelope surely does

allow is reliance on more conservative upstream intensity measurements for short periods if downstream readings are lost. Such a trade of intensity input documentation would have to be built into the software if it is to be available in a crunch.

And when we have the RHIC IPM giving us turn-by-turn beam widths that show we are not matched into the RHIC lattice, what do we do then? Will the analysis of this data be cast in a form that allows prediction of required changes in the incoming beam Twiss functions? Is this important? From what we know of the beam transverse emittance in RHIC (maybe the beam scans at store) the beam does not look to be big. And we know there is a shot-to-shot steering contribution to injection emittance growth. Nick and Woody seem confident that they could meet any request for Twiss parameter shifting. It is not clear who would formulate the request.

J Woody Glenn, 07:58 AM 11/20/00, Cross Interlock Upgrades

Received: from wglenn111 (pool47p.idas.bnl.gov [130.199.38.190]) by exchange01.bnl.gov with SMTP (Microsoft Exchange Internet Mail Service Version 5.5.2650.21)

id XBPNVG12; Mon, 20 Nov 2000 07:58:27 -0500

Message-Id: <2.2.32.20001120125831.006b89d4@exchange01.bnl.gov>

X-Sender: jglenn@exchange01.bnl.gov

X-Mailer: Windows Eudora Pro Version 2.2 (32)

Mime-Version: 1.0

Content-Type: text/plain; charset="us-ascii"

Date: Mon, 20 Nov 2000 07:58:31 -0500

To: jglenn@exchange.bnl.gov

From: J Woody Glenn <jglenn@bnl.gov>

Subject: Cross Interlock Upgrades

>Date: Sat, 18 Nov 2000 09:55:36 -0500

>To: dbvis, nwillm

>From: J Woody Glenn <jglenn@bnl.gov>

>Subject: Cross Interlock Upgrades

>Cc: jales, dbruno, ping, jsnd, tros, kgard, ntsp, wwnas

>X-Attachments: C:\09MyDc\Attach\atrLog1.jpg;

>

>Gentles -

>

>In order to reduce th number of RedTags and speed the switching between high intensity protons and RHIC, I'm proposing the following changes to the cross interlock. In addition to modifications to the ACS, various systems will need to be modified thus I've tried to identivy and cc experts in these systems. I've attached a complete logic diagram that includes new and old functions. I expect we'll need most of the changes 'on line' in March/April.

>

>Two Beam Stops installed between the high intensity source in the 35 KiV line. Alessi is suggesting diasbleing the first solonoide could act as one. This will be required when Polerized Protons are to be injected into Booster with RHIC running. - Alessi

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>The 8 & 20 degree arc PS's to be modified so that less than 20% normal curent, as monitored by failsave Rochester OC/UC relays, is considered OFF; and a hardwired clamp on the current referance does not premit larger currents. To assure that a low energy beam is not extracted through the 8 & 20 deg mags, the 4 degree PS will have to be monitored by a Rochester relay. - Bruno

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>The facility to replace the function of the LTBS1 stop with inhibiting DH1 should be expanded to incorporate the cross interlock. The control for this feature should be moved to the MCR and a Porcedure written to control operation. Ingrassia.

>

To: "dana beavis" <beavis@sgs1.hirg.bnl.gov>, lah, lah
From: J Woody Glenn <jglenn@bnl.gov>
Subject: Cross interlock review
Cc: nwillm, lah, tros
Bcc:
X-Attachments:

Dana -

The 'Cross Interlock' is to allow High intensity protons in the AGS with out LOTOing out the ATR line. This decreases the amount of time and confusion to switch between 'low & 'hi' intensity. Lsat year it was used a few tens of times until polarizrd protons were found to be 'low enough'.

Next year this 'interlock' will operate for each RHIC fill during part of the run. The proposed system reduces the number of 'breaker openings/closings' which should reduce power supply failures, reducing the chance of delaied refills.

I have scheduled the large conf room for Tuesday 2PM for a meeting. Let me know if this works for you.

When you have time please contact me so we can discuss and plan reviews for my suggested 'shutter'.

Thank you -

Woody

At 08:49 AM 11/30/00 -0600, you wrote:

>I am in meeting all week.

>As best as I can tell there is no information on the number of interlocks
>other then peoples memory. The memory is that there was not a lot of
>interlocks.

>I am inclined to leave it alone. If you feel strongly that this needs to be
>done/considered then we can call a committee meeting for next week.

>
>I think the resources could be put to better use.

>
>How are the shutters going for the AGS and Booster rings?

>
>dana

>
>----- Original Message -----

>From: J Woody Glenn <jglenn@bnl.gov>

>To: <beavis@HI2>

>Sent: Wednesday, November 29, 2000 1:15 PM

>Subject: X interlock

>

>

>> Dana -

>>

>> How to find you? I haven't beped as I'd hoped you'd call at your
>>convience.

>> Today's done, tomorrow after meeting. I'd like to get this rooling as

>> others have to do tasks. Thanks - Woody

>>

dana beavis, 10:53 AM 12/1/00 , Re: Cross interlock review

To: "dana beavis" <beavis@sgs1.hirg.bnl.gov>
From: J Woody Glenn <jglenn@bnl.gov>
Subject: Re: Cross interlock review
Cc:
Bcc:
X-Attachments:

Dana -

The most timely problem is to prevent the need to cycle the breakers on the 8 & 20 deg magnets for each switch between high intensity protons and Rhic Au injection. The next is to be able to switch between polarized protons for RHIC and high intensity protons w/o LOTO, and finally to be able to run the poliremeter w/o OPM 4.1.5 'modifications' and LOTO.

I'll rewrite more carefully and give the discription to Prnny along w/hardcopy of the logic for you. [Do you do better w/bit maps? Don't have a way to make .pdf's at this time.]

If you can't make Tues, can you apoint a designee?

Talk soon - Woody

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