Decision Record: Decommission the BSY Dump (1Q CY21) Rev 2

Jay Benesch for the Beam Transport Team
Concurring: Camille Ginsburg

Abstract

During late summer, in response to a request on future AIP planning, Jay Benesch examined the requirements to upgrade the BSY dump. This would require substantial magnet rework, a new 4 m dipole, and perhaps four new power supplies. Cost of order $500K. The Beam Transport Team (B team) discussed the need and decided there were many better ways to spend $500K if available. In November, in correspondence unfortunately deleted, Omar Garza asked if I&C needed to convert the BSY electronics from CAMAC to VME. Another discussion ensued. ATLis 21590 "Decommission the BSY dump" was written and distributed for comment.
http://opsweb.acc.jlab.org/CSUEApps/atlis/atlis.php?load=Task&task_id=21590
The B team affirmed January 5, 2021, that the BSY dump should be decommissioned.

Details re upgrade cost (Jay Benesch only)

From the relative bend angles of the BSY and Hall C lines, BdL of 16.2E6 G-cm is needed to get 11 GeV to the BSY dump. With the existing 475A power supply, new coils and added H steel, the three existing magnets should do 3*3.8E6 G-cm, or 11.4E6, leaving 4.8E6 required. At 475A, the 4m dipoles do 3.7E6. There is room to insert a 4 m dipole upstream of the three existing magnets. Since even the four magnets at 475A do not suffice, one or more new power supplies would be required; the 4m dipoles can be pushed a lot harder. It's not clear that the existing shunts can handle what would be necessary, so perhaps three new box supplies. Many of the BSY girders would have to be removed to get the H steel to the existing magnets and the 4 m dipole in place. The Magnet Test group would prefer to add H steel and measure the four in their shop. It's unlikely to be possible to move the three magnets through Hall C as the alcove aisle is narrow. It follows that several even arcs will have to be moved to get the magnets out to a service building. The cost and labor involved to upgrade the BSY are prohibitive; $500K is a WAG. The BSY dump was needed before the Hall line dumplettes were installed. It was rarely used after their installation. 12 GeV project management chose not to upgrade it as part of the Project, when the rest of the dipoles in the vicinity were upgraded and labor increment would have been modest. In a sense, the decision to decommission the BSY dump was made by Harwood over a decade ago.

The original Accelerator Physics group design for the spreaders/recombiners, but not the one imposed by Harwood, allowed for 12 GeV to A/B/C and 13 GeV to D. In support of this work I modeled all the dipoles, including the 3m straight arc dipoles, well into saturation. In response to a September 2020 query from Matt Bickley I ran a couple more models, out beyond the 645 A power supply limit. The BSY dipoles are curved but the pole widths are similar to the straight ones so the BdL(I) curves will be similar. I believe the reason for Matt's request was to be able to run fifth pass tune or CW beam fifth pass to the BSY dump so the 4-channel BPMs would register when Hall A was on a low pass and Halls B and D at full energy. I documented this work in the bi-weekly work reports I provided my supervisor while working from home during the pandemic. The text below comes from my Oct. 15-31 report and is rather cryptic, but likely useful as part of this document.

BSY dipole models with additional return steel MBJ to 645A (power supply limit) vs 475A now. This does not suffice as modified 3m arc dipole at 645A in twenty turns per coil set would provide 3.8E6 G-

cm vs 2.45E6 in unmodified BSY dipoles now at 475A, so 55% more. 5.4E6 G-cm is needed for fifth pass, 4.3E6 for fourth and 3.3E6 for third with each of three dipoles. Adding just the H steel would get us to third pass. Conductor is 9.5mm square by 5.5 mm diameter round hole. Coil pocket is 2.4" wide by 2.1" deep. Return steel is only 3", pole 4.6" deep max, curved. Change to 8 mm square with 4.5 mm hole, three doubles pancakes of six turns/pancake almost doubles the 20 turns now in each pocket. Add 3" A36 return steel on outside. 47.24 mm^2 so 475A is ~10 A/mm^2, no trouble water cooled with enough flow. 645 A fine too. Less insulation over conductor than at present, but 10 mils glass is ample with 2 mils polyimide. Say 0.005" B-staged glass-epoxy half-lapped, cure each double pancake, over-wrap half lap 1 mil Kapton for inter-pancake insulation. Booster pump likely needed to get enough cooling water through the 80 m cooling channel per double pancake. Or design a way to get a water circuit per (single) pancake while double pancake current channel remains continuous. Summarizing: BSY dipoles allow only second pass beam now. Adding H steel would get us to third pass. Adding H steel and new conductors should get to fourth pass. Moving the pick-off point upstream 4 m to add a new dipole at the end of the string gets us to fifth pass.

Since there's no way even with a new coil pack to make just three dipoles work at 11 GeV, the existing coil packs, providing 3.8E6 G-cm at 645A, could remain if the 4 m dipole is added and pushed well into saturation. Replacing the coils as discussed in italics above as well as adding the H steel is a more robust solution, albeit more expensive than pushing the 4 m and buying a separate power supply for it.

As Mike Tiefenback pointed out in an email in response to the first draft of this TN, the H steel can be added in segments rather than in one 3 m long, curved piece. Since precision isn't needed of the BdL(I) curves, just getting the beam to the dump, mapping is not mandatory: just use models. Installation of a 4 m dipole would require substantial material handling capability in the BSY region not now present. Mike also pointed out that the BSY dump raster system is clunky. I believe it's a 60 Hz AC Variac and is adjusted by estimating the size of the beam pattern on a viewer. This would have to be upgraded as well, perhaps to higher frequency to keep the dump safe.

As Mike also noted, Hall C was the first to come on line in the 4 GeV era. When Hall B came on line it was discovered that the stray field from the BSY dump C-format dipoles prevented the B beam from propagating. I designed a big steel box with open ends which was placed around the first BSY dipole to shield the B line from stray field. This is colloquially known as Jay's coffin. It might be that H magnets, even well into saturation, would confine the BSY dump line field well enough that the B line would be unaffected. This seems unlikely because the 4 m dipole would be installed much closer to the B line. An external shield may be required to supplement the H steel..

Comments on the ATLis

12/04/20 09:46 COMMENT ON by J_Kowal:
A quick glance indicates that it should be possible to disconnect BSY Dump Box Supply, lock the dipole leads with PSS Configuration Locks and install Off/Safe Jumpers for this Box Supply. No other PSS changes should be required.

In addition there are several MPS components, which are connected to the FSD and will require at a minimum configuration changes (and removal).

SSG can't take any of these tasks until work already planned and committed is finished. So, if there is time left, the earliest we can review it in detail and work on it is just before PSS Certification in the spring.

12/08/20 22:59 COMMENT ON by S_Philip:
Magnets can be decommissioned and magnet power supplies/shunts used elsewhere in the machine (as needed). The BSY Raster magnet can also be decommissioned (once MPS related hardware has been disconnected).

12/10/20 13:41 COMMENT ON by K_Cole:
I&C systems including: FSD interlock chassis, transducer monitor, and CAMAC status controls can be powered down when ready to move forward with this task. The vac valve control at 4C00A will also be unplugged and tagged out. Spoke with Neil and installation group is ready to secure their systems also.

12/11/20 07:30 COMMENT ON by N_Wilson:
From an INST point, we can blow out both water circuits, shut off the N2 head pressure and leave as is. We will have to coordinate with Radcon as the water in the AL circuit is considered contaminated and must be handled as such.

Email 12/8/20 from Mike McCaughan which was incorporated in the ATLis

I'm on-site today so I figured I'd take a stab at putting together a task list for the decommissioning of the BSY dump while I have ready access to the control system. Please have a look over the below and see if you can think of any changes or modifications which should be made and then we can add it to Jay's ATLis or run in by the respective group leaders as is appropriate... Also as we start putting together a tech note, I pulled some of this information together back when I wrote note JLAB-TN-17-059. Perhaps that or some of its references would be useful to the process.
Mike

Task list:
EES-DC:
Pull leads from MBSYBD and lock out leads at supply. Supply may then be repurposed.
Optional: Disconnect leads downstairs on MBJ4C01/2/3 locally.
Update CED showing MBSYBD as unpowered. This will propagate appropriate screen changes.

Pull trim cards powering the following:
Disconnect A/C power supply powering MSY4C00H/V (MSY raster) in BSY service building and lock it out. Update in CED as unpowered.
MBD4C00V: Rack BS04B13 - remove 10A trim card from Channel 15. Update in CED as unpowered.

EES-IC/Vacuum:
Valve VBV4C00B should be closed and locked out
VIP4C00B should remain on for the present time
VTC4C00 should remain active for the present time for monitoring purposes

Remove cables from the following diagnostics (or simply turn them off):
ITV4C00
IPM4C00: Bypass BPM first IOCSE18.
IBC4C00: IBC4C00 has input to both BELS and the BLA system. Any reconfiguration necessary to those 2 systems should be handled by their respective system owners with EES-IC input.

SSG:
Affected BLMs:
ILM4C01
ILM4C02
ILM4C03

On HV control card IHVBS1 Card 00 channels 3, 4, and 5 should be turned off. HV cables should be both disconnected upstairs at the supply and the BLM heads removed downstairs to have available as ready spares if desired.

FSD changes (SSG/software):
-Channels 3/4/5 on BLMBS01 should be masked in BSY/Hall gold masking as appropriate.
-BSY_1 card Channels 3/4: BELSOpsEnvelope1 & 2; SSG should confirm a lack of input from the BSY BCM (IBC4C00) will not cause a system error. If it does, and the schedule does not allow time for reconfiguration the BCM may be left cabled with beam off.
-BSY_1 card Channel 5: 2 devices: Should be masked in BSY/Hall gold masking for VBV4C00A. VBV3C00A is redundantly protected by channel 6 for the Hall C setup, or work to the dumplettes.
-If the above powering changes necessitate reconfiguration of channel 8 on the BSY_2 card (SOFTIHVBS1 CAEN HV Fault) that should be corrected on a hardware or softioc level as appropriate.
-BSY_3 card channel 5: 2 devices BSY Raster may be masked in gold masking for BSY/Hall segment
-BSY_3 card channel 6: IBD4C00 (High Power Dump) may be masked in gold masking for the BSY/Hall segment

Install:
IBD4C00/IDW4C00 should be left in what is determined by facilities to be a safe state. Neil mentioned emptying the water supply and placing the system on a Nitrogen purge previously. Isolate Copper/Aluminum circuits from LCW system as necessary and purge. Disconnect/turn off flow, presure, level, and thermal monitoring as appropriate. Turn off and lock out any unnecessary chassis supporting these devices with the assistance of EES-IC.

Mechanical Engineering:
Document ACC-000-2845-0031 (Song sheet of affected area) should be updated according with changes to show depowered and uninstalled components.
https://misportal.jlab.org/jlabDocs/seam/docstore/document.seam?docId=1&cid=11507

Software:
Next HCO verify all CED changes have been applied, or motivate system owners accordingly.

Ops/Ops management:
Make all appropriate changes to procedures, check lists, and safety documentation as determined by management chain + accelerator DSO. Hall C liaison update quick reference drawing.