Decision Record: Decommission the BSY Dump (1Q CY21) Rev 3

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.

Fundamentals

The BSY dump as installed reaches only second pass. 100 kW allows ~44 μA. Scraping and activation issues begin only on third pass, with 5S01 BLM trips and 7A activation. Beam emittance and size are not appreciably larger than the 6 GeV era until arc 6 (synchrotron radiation) but the spreader/recombiner optics is much more sensitive to errors than the original layout. It follows that at least third pass and preferably fourth would be needed to use the BSY dump to diagnose CW issues. On fourth pass only 10 μA would be allowed. Often scraping and halo issues don't become apparent at such 10 CW currents because the linac RF systems are so modestly loaded. In the recent run to Hall C five pass, 20 μA was often the problem threshold.

Hall B has asked that the BSY dump be transferred to the hall for use as a 10 kW dump so they do not have to design one at 10 kW or buy a new 100 kW unit to eliminate design costs. Steve Suhring believes it would be possible to remove the BSY dump with modest beam line disruption as it's only about 35 cm diameter by 150 cm long overall, with three or four segments comprising the length (I can't read the drawings well. JB)

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.

Appendix: Email discussion from November 2020

Re: BSY Dump. Is it needed?
Matthew Bickley
Tue 11/10/2020 5:08 PM
All,
In mid-FY20 when Camille and I met with Mike Spata to talk about AIP projects for upcoming years (after LLRF3.0 and the injector energy upgrade are complete), the list we discussed included upgrading the BSY to enhance its capability to better support operation of 12 GeV CEBAF. We should expect that at some time we'll be doing so...perhaps on AIP, perhaps funded somewhere else. When we next revisit our long-term AIP plans, we'll still have this on the list of prospects, as well as the other projects Jay mentioned in his email. At that time we'll be evaluating their relative priorities, and deciding which we should pursue most urgently.

Matt

From: Paul Vasilauskis <vasilaus@jlab.org>
Sent: Tuesday, November 10, 2020 3:21 PM
To: Steve Suhring <suhring@jlab.org>; Camille Ginsburg <ginsburg@jlab.org>; Jay Benesch <benesch@jlab.org>; Matthew Bickley <bickley@jlab.org>
Cc: Randy Michaud <rmichaud@jlab.org>; Rick Gonzales <gonzales@jlab.org>; Omar Garza <garza@jlab.org>; Keith Cole <colek@jlab.org>
Subject: Re: BSY Dump. Is it needed?

Dear Colleagues,
I sent your emails to my senior Crew Chiefs to get their opinion on whether the BSY dump is operationally needed or not just so I wasn't missing something.

From Mike McCaughan:

> Hi Paul,
> I personally think it would be a poor idea for us to discard the BSY dump as a beam destination. We have used it on occasion for first pass setup even in the present machine, and the only reason we haven't used it more if due to the goofy way the power supply is presently configured where DC power has to lock out one supply to the other based on power rated in the conduit for the present configuration. If we get them to drop the cable down a different penetration that should restore independent control of the supply if I understand things correctly. So to Jay's list below I would add both this and the upgrade to the undersized BSY raster (which is a modified sextupole with a power supply straining it at 6 GeV).
>
> Why we should keep it:

> -ALARA: The dumplettes are only rated for 2 kW and even at that we have shown the propensity to activate them to greater than 1R over the course of even a single shift of extensive use.
> -By it's nature this is clearly a phased project as Jay notes... we don't have $0.5M to spend at a go, we have several tens of thousands to spend over a multi-year period on the project. This makes it a good candidate for an Accelerator Improvement Project (AIP) which is a different flavor of money provided by the DOE outside the normal operating budget.
> -Machine protection (BELS/BLA/BLMs): The 100kW nature of the dump makes it a good location to send to on any pass (when we aren't locked out) to terminate beam without a great deal of effort and send a lot of current in CW to stress the system and see where corners are missteered, check for scraping, etc. We haven't done this recently due to both the lock out conditions and the fact the operations group hasn't been given a great deal of input with regard to start-up time tables recently and so everything has been very last minute/shot gun with barely enough time to accomplish necessary tasks.
> -RF check out with beam: In the past this has proven to be a much better place to park beam than dumplettes (due to activation) to tune up the RF with beam for phasing, setting up attenuators and clamps, etc. when we are given the time.
> -Beam studies/Optics: This decouples the machine from the need to use Hall A or C for high power studies; frequently their time tables are crowded independently with their own installation schedules so getting extra high current time for check out from them has been challenging in the best of circumstances. Needlessly sacrificing this capability would only be to our detriment.
> -Work required: The engineering work and studies (including heat deposition, monte carlo, etc) for the project is already done and the labor has been paid for. The upgrade path has been studied and is straight forward. It's a 'shovel ready' project where even if we aren't using AIP money it is a good candidate for prioritization as necessary by Camille during budget reconciliation time at the end of the fiscal year to buy equipment. Installation would be on RSR money as it always has been.
>
> My 2 cents.
> Mike

Mike also added:

> I forgot to add that I think the number was also closer to 300k... Arne spec-ed it out in one of the tech notes during or after the 12 GeV upgrade once he saw the project skimped on it. I'm digging for the note now...

He has not yet followed up with whether he found the Tech-Note.

From Terry Carlino:

> There is also the Hall C factor. The BSY dump cannot be used when Hall C is receiving beam, that is even apart from limitations with box supplies.
> Over all a BSY dump as it is configured now is not useful enough to maintain in my opinion.

> Likewise any use we could get out of the BSY dump even if it could do 5 pass would not justify investment of 500K. Spend a fraction of that and install better shielding for the hall insertable dumps so that we can run tune beam for a witness beam for months without creating a high rad area in the BSY.
> Better yet invest it in better BPM electronics and then we wouldn't need a witness beam.

We haven't used the BSY dump in a while mainly due to it not being able to handle more than 2 pass energy levels. Running to a dumplette works for a temporary time frame (hall temporarily down...) but should not be a permanent solution for a whole run. As for an ALARA issue. The BSY is not a segment that gets much traffic. It is accessible from both ends so roping off a chunk in the middle of an area with little traffic is not a big deal.

Just wanted to present as much info as possible.
Paul

From: Steve Suhring <suhring@jlab.org>
Sent: Tuesday, November 10, 2020 6:46 AM
To: Rick Gonzales <gonzales@jlab.org>; Omar Garza <garza@jlab.org>; Keith Cole <colek@jlab.org>
Cc: Matthew Bickley <bickley@jlab.org>; Camille Ginsburg <ginsburg@jlab.org>; Jay Benesch <benesch@jlab.org>; Paul Vasilauskis <vasilaus@jlab.org>; Randy Michaud <rmichaud@jlab.org>
Subject: FW: BSY Dump. Is it needed?

Hi Steve (Omar and Keith),
There is an interlock chassis (with obsolete ICs) that ties many signals into the FSD system that should be replaced along with what looks like bad (Aluminum loop) flow and temperature sensors. Also we want to remove an old Jorway 45 I/O card and replace it with another interface. My understanding is that once the old Jorway 45 comes out, the CAMAC crate that it presently houses can also be physically removed permanently.
Any urgency? Any need? Can the skid be given a multi year rest?

Rick Gonzales
****

Hi Rick,

I felt that I should poll the CASA folks and Camille. The email string can be read below.

As suspected, the BSY Dump is not needed any time soon, if ever.

Here are my follow-up thoughts. They go way beyond your original question/proposal and include many other groups. The list seems like a logical outfall of your work. I'll send this out to Matt Bickley (and some others in OPS) for consideration as a real project needing real planning and real oversight.

Please submit an ATLis for your proposed work to remove the dump chassis. The following list might get addressed separately.

Thanks!

Steve

****

As you decommission the electronics, be sure to include Jerry for the removal of the FSD interlocks.
Signals need to be retired from the CED.
Screens checked.
Decommissioning of the pump skid needs to be thought through: Radcon, INST (Wilson).
Should we consider removing the BCM from the line? Would this improve the Beam Loss Accounting System and (possibly) free up some equipment?
Maybe we should go ahead and decommission the BSYBD power supply? Again, maybe it could be repurposed somewhere?
Maybe vent and blank off the BSYBD line down near the split?
Eliminate the FSD node for the entire BSY transport line and the sometimes confusion of proper masking?

Sounds like this could be bigger than just removing the dump chassis.

Steve
****

From: Yves Roblin <roblin@jlab.org>

Sent: Monday, November 9, 2020 8:30 PM

To: Camille Ginsburg <ginsburg@jlab.org>; Todd Satogata <satogata@jlab.org>; Steve Suhring <suhring@jlab.org>; Jay Benesch <benesch@jlab.org>; Mike Spata <spata@jlab.org>; Michael Tiefenback <tiefen@jlab.org>

Subject: RE: BSY Dump. Is it needed?

indeed not needed for 12GeV. However we might find use for the hardware to make a dump for CEBAF ER should it be approved.

-------- Original message --------
From: Camille Ginsburg <ginsburg@jlab.org>
Date: 11/9/20 8:17 PM (GMT-05:00)

To: Todd Satogata <satogata@jlab.org>, Steve Suhring <suhring@jlab.org>, Jay Benesch <benesch@jlab.org>, Mike Spata <spata@jlab.org>, Yves Roblin <roblin@jlab.org>, Michael Tiefenback <tiefen@jlab.org>
Subject: Re: BSY Dump. Is it needed?

Thanks everyone for the discussion. I don't hear any counterarguments.

Best wishes,
Camille

From: Todd Satogata <satogata@jlab.org>
Sent: Monday, November 9, 2020 7:31 PM
To: Steve Suhring <suhring@jlab.org>; Jay Benesch <benesch@jlab.org>; Camille Ginsburg <ginsburg@jlab.org>; Mike Spata <spata@jlab.org>; Yves Roblin <roblin@jlab.org>; Michael Tiefenback <tiefen@jlab.org>
Subject: Re: BSY Dump. Is it needed?

Hey all,

10-4 -- seems like there is consensus that retiring the BSY dump is acceptable, with no real use in the 12 GeV era. Thanks for looping us in!

-Todd

==========

Todd Satogata
Director, Center for Advanced Studies of Accelerators
Jefferson Lab
12000 Jefferson Avenue
Newport News, VA 23606
Cell: (631) 807-0674

==========

On 11/9/20 6:45 PM, Steve Suhring wrote:
> Sounds good to me.
> Thanks!
> Steve
>
> -----Original Message-----
> From: Todd Satogata <satogata@jlab.org>
> Sent: Monday, November 9, 2020 3:28 PM
> To: Steve Suhring <suhring@jlab.org>; Jay Benesch <benesch@jlab.org>; Camille Ginsburg <ginsburg@jlab.org>; Mike Spata <spata@jlab.org>; Yves Roblin <roblin@jlab.org>; Michael Tiefenback <tiefen@jlab.org>

> Subject: Re: BSY Dump. Is it needed?
>
> Hi Steve,
>
> I'm looping through Yves and Mike Spata -- I had thought that the BSY is used in the current upstream XA/XB matching procedure. Perhaps one of them will comment directly to this thread. I'm not aware of any other obvious need for the BSY dump, but let's confirm with Mike and Yves so we can all be on the same page. (I also CC:'d Tief just to get all historical APELs in the loop.)
>
> -Todd
>
> ==========
> Todd Satogata
> Director, Center for Advanced Studies of Accelerators Jefferson Lab
> 12000 Jefferson Avenue
> Newport News, VA 23606
> Cell: (631) 807-0674
> ==========
>
> On 11/9/20 3:25 PM, Steve Suhring wrote:
>> Todd? Camille?
>>
>> Thanks, Jay. We haven't used it in quite some time (12GeV era?).
>>
>> Steve
>>
>> -----Original Message-----
>> From: Jay Benesch <benesch@jlab.org>
>> Sent: Monday, November 9, 2020 3:20 PM
>> To: Steve Suhring <suhring@jlab.org>; Camille Ginsburg
>> <ginsburg@jlab.org>; Todd Satogata <satogata@jlab.org>
>> Subject: Re: BSY Dump. Is it needed?
>>
>> Colleagues,
>>
>> Material from the to-do list I've been sending Camille bi-weekly, omitting all but the summary:
>> "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."
>>
>> B team discussion has been that only a fifth pass capable BSY dump has utility. I guess $50K per coil set and H steel; $150 K for a new 4 m dipole. Plus a new power supply or several. So my WAG would be $500K for the full upgrade. I can see much better places to spend $500K, so I'd retire the BSY for now.
>>
>> Jay
>> _____

>> From: Steve Suhring <suhring@jlab.org>
>> Sent: Monday, November 9, 2020 3:05 PM
>> To: Camille Ginsburg; Jay Benesch; Todd Satogata
>> Subject: FW: BSY Dump. Is it needed?
>>
>> Colleagues,
>>
>> Can you please think about the question posed: Do we need the BSY Dump?
>>
>> Steve
>>
>> From: Rick Gonzales <gonzales@jlab.org>
>> Sent: Monday, November 9, 2020 11:28 AM
>> To: Steve Suhring <suhring@jlab.org>
>> Cc: Omar Garza <garza@jlab.org>; Keith Cole <colek@jlab.org>
>> Subject: BSY Dump. Is it needed?
>>
>> Hi Steve (Omar and Keith),
>> There is an interlock chassis (with obsolete ICs) that ties many signals into the FSD system that should be replaced along with what looks like bad (Aluminum loop) flow and temperature sensors. Also we want to remove an old Jorway 45 I/O card and replace it with another interface. My understanding is that once the old Jorway 45 comes out, the CAMAC crate that it presently houses can also be physically removed permenently.
>> Any urgency? Any need? Can the skid be given a multi year rest?
>>
>> Rick Gonzales
>>