Person: Sawatzky, Brad (brads@jlab.org)
Org: PHALLC

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Submitted: 8/11/2021 10:22:56 AM

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Operational Safety Procedure Review and Approval Form # 119371
(See ES&H Manual Chapter 3310 Appendix T1 Operational Safety Procedure (OSP) and Temporary OSP Procedure for Instructions)

Type:	***OSP*** Click for OSP/TOSP Procedure Form Click for LOSP Procedure Form Click for LOTO-COMPLEX Information Click for LOTO-GROUP Information		
Serial Number:	***ENP-21-119371-OSP***		
Issue Date:	***8/18/2021***		
Expiration Date:	***6/18/2023***		
Title:	***GEN-RP SBS Polarimeter Detectors***		
Location: (where work is being performed) Building Floor Plans	***101 - Experimental Hall A - A100***	Location Detail: (specifics about where in the selected location(s) the work is being performed)	***Experimental Hall A***
Risk Classification: (See ES&H Manual Chapter 3210 Appendix T3 Risk Code Assignment)	Without mitigation measures (3 or 4): ***3*** With mitigation measures in place (N, 1, or 2): ***1***		
Reason:	This document is written to mitigate hazard issues that are : ***Determined to have an unmitigated Risk code of 3 or 4***		
Owning Organization:	***PHALLA***		
Document Owner(s):	***Sawatzky, Brad (brads@jlab.org)*** Primary		

Supplemental Technical Validations

Mode 1: Class 1, 2, and 3 Electrical Equipment (Phillip Stanley, Tim Fitzgerald)
ESH&Q Liasion (Bert Manzlak)

Other Hazards:
PMT High Voltage (Jack Segal)

Document History

Revision	Reason for revision or update	Serial number of superseded document

Lessons Learned	Lessons Learned relating to the hazard issues noted above have been reviewed.

Comments for reviewers/approvers:	

Attachments
Procedure: ***OSP-Form-scintillators.pdf***
THA: ***THA-form-scintllators.pdf***
Additional Files: ***GEn-RP_Polarimeter_Manual.pdf***

Review Signatures	
Person : Subject Matter Expert : PMT High Voltage	**Signed** on 8/11/2021 11:14:35 AM by Jack Segal (segal@jlab.org)
Subject Matter Expert : Electricity->Mode 1: Class 1-> 2-> and 3 Electrical Equipment	**Signed** on 8/12/2021 7:34:35 AM by Phillip Stanley (pstanley@jlab.org)

Approval Signatures	
Division Safety Officer : PHALLA	**Signed** on 8/12/2021 7:54:47 AM by Ed Folts (folts@jlab.org)
ESH&Q Division Liasion : PHALLA	**Signed** on 8/12/2021 7:53:58 AM by Bert Manzlak (manzlak@jlab.org)
Org Manager : PHALLA	**Signed** on 8/18/2021 2:10:50 PM by Cynthia (Thia) Keppel (keppel@jlab.org)
Safety Warden : Experimental Hall A - A100	**Signed** on 8/12/2021 7:35:41 AM by Jessie Butler (jbutler@jlab.org)

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Operational Safety Procedure Form

(See ES&H Manual Chapter 3310 Appendix T1 Operational Safety Procedure (OSP) and Temporary OSP Procedure for instructions.)

Click For Word Doc

Title:	GEn-RP Scintillator based sub-detectors (“Active Analyzer”, 2 Hodoscope arrays)		
Location:	Experimental Hall A	**Type:**	■ **OSP** ☐ **TOSP**
Risk Classification (per Task Hazard Analysis attached) (See *ES&H Manual Chapter 3210 Appendix T3 Risk Code Assignment*.)		**Highest Risk Code Before Mitigation**	2
		Highest Risk Code after Mitigation (N, 1, or 2):	N
Owning Organization:	Physics Division / Hall A	**Date:**	8/5/2021
Document Owner(s):	Brad Sawatzky <brads@jlab.org>		

DEFINE THE SCOPE OF WORK

1. Purpose of the Procedure – Describe in detail the reason for the procedure (what is being done and why).

This OSP covers operation of the scintillator based detectors used in the GEn-RP polarimeter to be installed on the SBS. There are three sub-dectetors in this category: an “Active analyzer” and two hodoscope scintillator arrays.

The GEM-based components are covered in their own OSP(s).

2. Scope – include all operations, people, and/or areas that the procedure will affect.

Users will control the photomultiplier (PMT) high-voltages (HV) through the standard Hall A HV control GUI.

3. Description of the Facility – include building, floor plans and layout of the experiment or operation.

The three scintillator + PMT based sub-detectors are part of the GEn-RP polarimeter assembly that will be installed on the SBS carriage in Hall A.

ANALYZE THE HAZARDS and IMPLEMENT CONTROLS

4. Hazards identified on written Task Hazard Analysis

Photomultiplier high voltage.

See also: attached THA and GEn-RP Polarimeter Detector Manual.

5. Authority and Responsibility:

5.1 Who has authority to implement/terminate

B. Sawatzky

5.2 Who is responsible for key tasks

B. Sawatzky

5.3 Who analyzes the special or unusual hazards including elevated work, chemicals, gases, fire or sparks (See ES&H Manual Chapter 3210 Appendix T1 Work Planning, Control, and Authorization Procedure)

N/A

6. Personal and Environmental Hazard Controls Including:

6.1 Shielding

N/A

6.2 Barriers (magnetic, hearing, elevated or crane work, etc.)

N/A

6.3 Interlocks

N/A

6.4 Monitoring systems

High voltage settings, currents, and trip status are monitored by the Hall A HV GUI.

6.5 Ventilation

N/A

6.6 Other (Electrical, ODH, Trip, Ladder) (Attach related Temporary Work Permits or Safety Reviews as appropriate.)

PMTs are powered by standard high-voltage/low-current power supplies through appropriately rated SHV terminated RG-59 cables.

7. List of Safety Equipment:

7.1 List of Safety Equipment:

N/A

7.2 Special Tools:

N/A

8. Associated Administrative Controls

N/A

9. Training

9.1 What are the Training Requirements (See List of Training Skills)

N/A

DEVELOP THE PROCEDURE

10. Operating Guidelines

See attached GEn-RP Polarimeter detector manual.

11. Notification of Affected Personnel (who, how, and when include building manager, safety warden, and area coordinator)

N/A

12. List the Steps Required to Execute the Procedure: from start to finish.

N/A

13. Back Out Procedure(s) i.e. steps necessary to restore the equipment/area to a safe level.

N/A

14. Special environmental control requirements:

14.1 List materials, chemicals, gasses that could impact the environment (ensure these are considered when choosing Subject Mater Experts) and explore EMP-04 Project/Activity/Experiment Environmental Review below

N/A

14.2 Environmental impacts (See EMP-04 Project/Activity/Experiment Environmental Review)

N/A

14.3 Abatement steps (secondary containment or special packaging requirements)

N/A

15. Unusual/Emergency Procedures (e.g., loss of power, spills, injury, fire, etc.)

In the event of injury, or an immediate emergency exists, call **911** and also notify:

- Guards (**x5822**)
- Occupational Medicine (**x7539**)
- Crew Chief (**x7045**) (if inside the fence)

In case of an injury follow standard JLAB procedures. Initial response cards are located with each phone for appropriate emergency phone numbers. Additional information can be found at https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-24400/*.pdf.

16. Instrument Calibration Requirements (e.g., safety system/device recertification, RF probe calibration)

17. Inspection Schedules

18. References/Associated/Relevant Documentation

GEn-RP Polarimeter detector manual (attached).
THA (attached).

19. List of Records Generated (Include Location / Review and Approved procedure)

Submit Procedure for Review and Approval (See ES&H Manual Chapter 3310 Appendix T1 OSP & TOSP Instructions – Section 4.2 Submit Draft Procedure for Initial Review):

- Convert this document to .pdf
- Open electronic cover sheet: https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-24048/3310T1Form.doc
- Complete the form
- Upload the pdf document and associated Task Hazard Analysis (also in .pdf format)

Distribution: Copies to Affected Area, Authors, Division Safety Officer

Expiration: Forward to ES&H Document Control

Form Revision Summary

Revision 1.7 – 02/25/2021 – Corrected link to Word doc; updated 'ESH&Q' to "ES&H'; other minor edits. No approval required.

Revision 1.6 – 06/23/2020 – Update section 15 to reflect guard number, what to do in an emergency, crew chief numbers, etc. approved by H. Fanning

Revision 1.5 – 04/11/18 – Training section moved from section 5 Authority and Responsibility to section 9 Training

Revision 1.4 – 06/20/16 – Repositioned "Scope of Work" to clarify processes

Qualifying Periodic Review – 02/19/14 – No substantive changes required

Revision 1.3 – 11/27/13 – Added "Owning Organization" to more accurately reflect laboratory operations.

Revision 1.2 – 09/15/12 – Update form to conform to electronic review.

Revision 1.1 – 04/03/12 – Risk Code 0 switched to N to be consistent with 3210 T3 Risk Code Assignment.

Revision 1.0 – 12/01/11 – Added reasoning for OSP to aid in appropriate review determination.

Revision 0.0 – 10/05/09 – Updated to reflect current laboratory operations

ISSUING AUTHORITY	FORM TECHNICAL POINT-OF-CONTACT	APPROVAL DATE	REVIEW DATE	REV.
ES&H Division	Harry Fanning	04/11/18	02/25/24	1.6

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Task Hazard Analysis (THA) Worksheet

(See ES&H Manual Chapter 3210 Appendix T1
Work Planning, Control, and Authorization Procedure)

Click For Word

Author:	Brad Sawatzky	**Date:**	August 6, 2021	**Task #:** If applicable	

Complete all information. Use as many sheets as necessary

Task Title:	GEn-RP Scintillator Based Detectors ("Active Analyzer" and Hodoscope Planes)			**Task Location:**	Experimental Hall A
Division:	Physics	**Department:**	Hall A	**Frequency of use:**	Daily
Lead Worker:	Brad Sawatzky				
Mitigation already in place: Standard Protecting Measures Work Control Documents					

Sequence of Task Steps	Task Steps/Potential Hazards	Consequence Level	Probability Level	Risk Code (before mitigation)	Proposed Mitigation (Required for Risk Code >2)	Safety Procedures/ Practices/Controls/Training	Risk Code (after mitigation
	Electrical shock from photomultiplier high voltage	M	L	2	Use of current limited high voltage supplies (3kV max, 3mA max). Use of SHV cables and connectors. Cabling is rated at >4 kV	High voltage cables are only connected or disconnected to/from detectors, power supplies and patch panels when power supply is not engaged.	1

Highest Risk Code before Mitigation:		**Highest Risk Code after Mitigation:**	

When completed, if the analysis indicates that the Risk Code before mitigation for any steps is "medium" or higher (RC ≥ 3), then a formal Work Control Document (WCD) is developed for the task. Attach this completed Task Hazard Analysis Worksheet. Have the package reviewed and approved prior to beginning work. (See ES&H Manual Chapter 3310 Operational Safety Procedure Program.)

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Task Hazard Analysis (THA) Worksheet

(See ES&H Manual Chapter 3210 Appendix T1
Work Planning, Control, and Authorization Procedure)

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Task Hazard Analysis (THA) Worksheet

(See ES&H Manual Chapter 3210 Appendix T1
Work Planning, Control, and Authorization Procedure)

Form Revision Summary

Revision 0.2 – 07/26/21 – Periodic Review; updated header and footer
Periodic Review – 08/29/18 – No changes per TPOC
Periodic Review – 08/13/15 – No changes per TPOC
Revision 0.1 – 06/19/12 - Triennial Review. Update to format.
Revision 0.0 – 10/05/09 – Written to document current laboratory operational procedure.

ISSUING AUTHORITY	TECHNICAL POINT-OF-CONTACT	APPROVAL DATE	REVIEW DATE	REV.
ES&H Division	Harry Fanning	08/29/18	07/26/24	0.2

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GEn-RP SBS Polarimeter Detector Systems Overview and Operation

B. Sawatzky

08 August 2021

1 Overview

The GEn-RP polarimeter is composed of five sub-detectors installed on the SBS carriage downstream of the SBS dipole. Figurepolarim shows a CAD rendering of these detectors on the SBS carriage.

- One "inline frame" supporting eight GEM layers (2 INFN layers and 6 UVa X-Y layers) and a removable steel plate used as a passive analyzer.
- Two "side detector" assemblies, each consisting of 2 UVa X-Y GEM layers and one 24 paddle hodoscope array.
- One "CH analyzer", or *Active* analyzer made of 32 scintillator bars in a 4x8 grid arrangement.
- The polarimeter also makes use of the SBS HCAL hadron calorimeter. This is part of the standard SBS equipment which is covered elsewhere.

2 GEM Layers Operating Procedures

Operating procedures for the GEM layers used in the inline frame and the two side detectors are addressed in the following OSP:

- OSP 113037: GEM detectors for the SBS experiment [1]

The GEM systems will not be discussed further in this document.

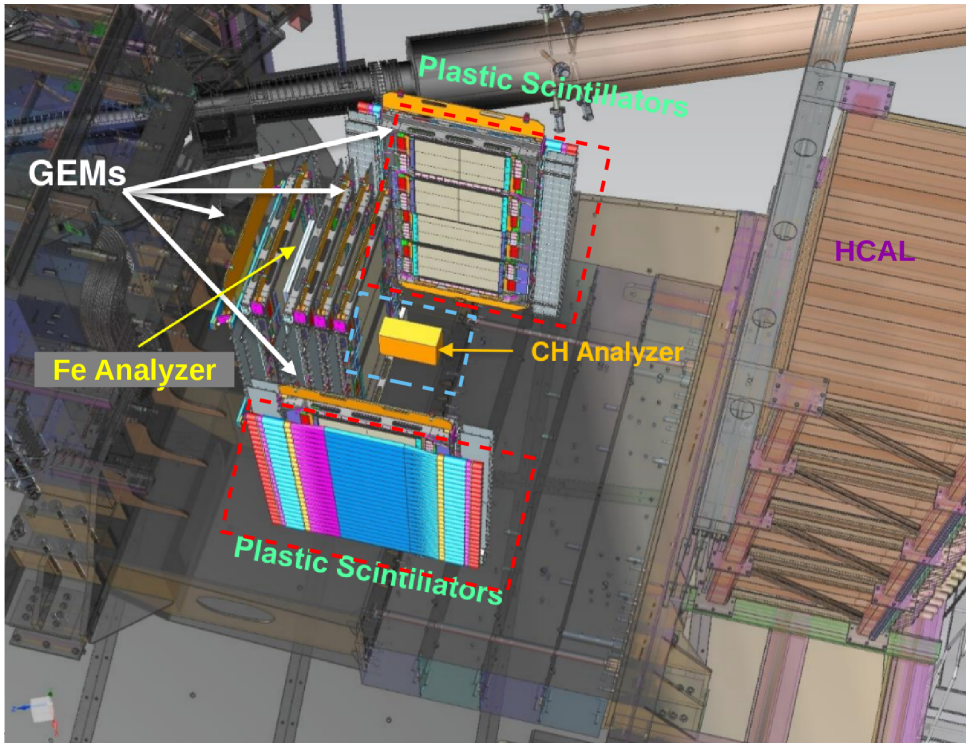

Figure 1: CAD rendering of the GEn-RP polarimeter components installed on the SBS carriage. The "inline frame" contains 8 parallel GEM layers facing the primary target downstream of the SBS dipole. The frame also supports a removable steel plate sandwich between the four upstream and 4 downstream GEM layers. The plate functions a passive analyzer using the charge-exchange process. Immediately downstream is the "Active" CH analyzer (within the light-blue dashed square) followed by HCAL on the right of the image. At the top and bottom of the image (red dashed squares) are the "Side detector" assemblies, each containing two back-to-back X-Y GEM layers and one 24 paddle hodoscope array.

3 Inline Frame

3.1 Installation/Deinstallation and the Rail System

The Inline Frame is designed to be moved/lifted with all GEM layers already installed, but the steel plate *must be removed* prior to any lift operation on the Inline Frame.

3.1.1 Checklist for Installation/Deinstallation of the Inline Frame

- Ensure that the Steel analyzer plate is *removed*.
- Ensure all high voltage, signal, gas lines, ground cables are *removed*.

[1] https://mis.jlab.org/mis/apps/mis_forms/operational_safety_procedure_form.cfm?entry_id=113037

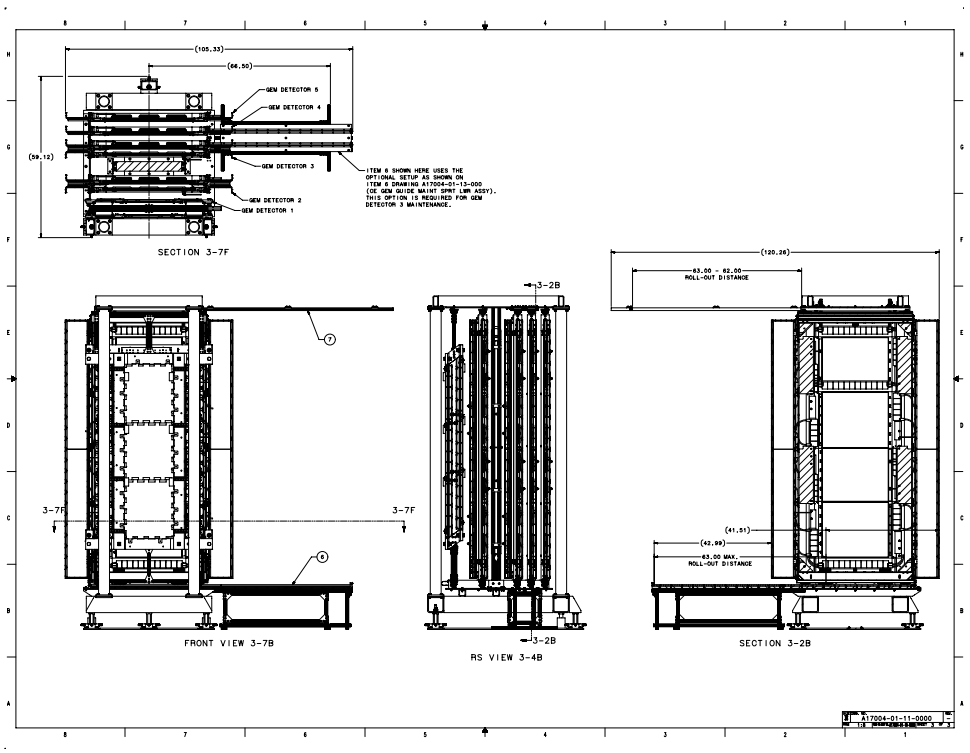

Figure 2: CAD model of the GEn-RP polarimeter Inline Frame. It contains 8 GEM layers and a slot for a removable steel analyzer plate. The rail extensions shown in this image are used only for installation or repairs, and are removed for production. From left-to-right in RS-VIEW 3-4B the components are: 2 INFN layers on a single rail mount; 2 UVa X-Y layers on a single rail mount; Slot/holder for steel analyzer plate; 2 UVa X-Y layers on a single rail mount; 1 UVa X-Y layer on a single rail mount; 1 UVa X-Y layer on a single rail mount.

- Attach protective guard panels to any accessible, exposed, GEM gas windows.
- Ensure that all five (3 double GEM + 2 single GEM) layer sub-assemblies are secured on their rails using the pins and rail clamps.

3.1.2 Checklist for using Rail Assembly

Note: Only one layer may be rolled out at a time. This *must* be organized with the support of the System Owner and the Hall A Work Coordinator. Any individuals working on the SBS carriage must ensure they have appropriate Fall protection and/or other training as required. Follow signage and check with the Hall Work Coordinator if unsure.

- Ensure all high voltage to *all eight* GEM layers in the Inline Frame is OFF.
- Disconnect necessary signal, HV, and gas line cabling.

- Install the rail extension assemblies to the bottom and top rails for the layer to be worked on. Ensure they mate cleanly with the permanent rail both top and bottom and the extensions are secure.
- Remove the rail clamp and pin to allow the sub-detector assembly to move freely on its rail.
- Move the sub-detector assembly slowly and carefully, being sure to watch for any cables that may snag and/or contact gas windows of the adjacent GEM layers.

4 "Side Detector" Polarimeter Hodoscope Arrays

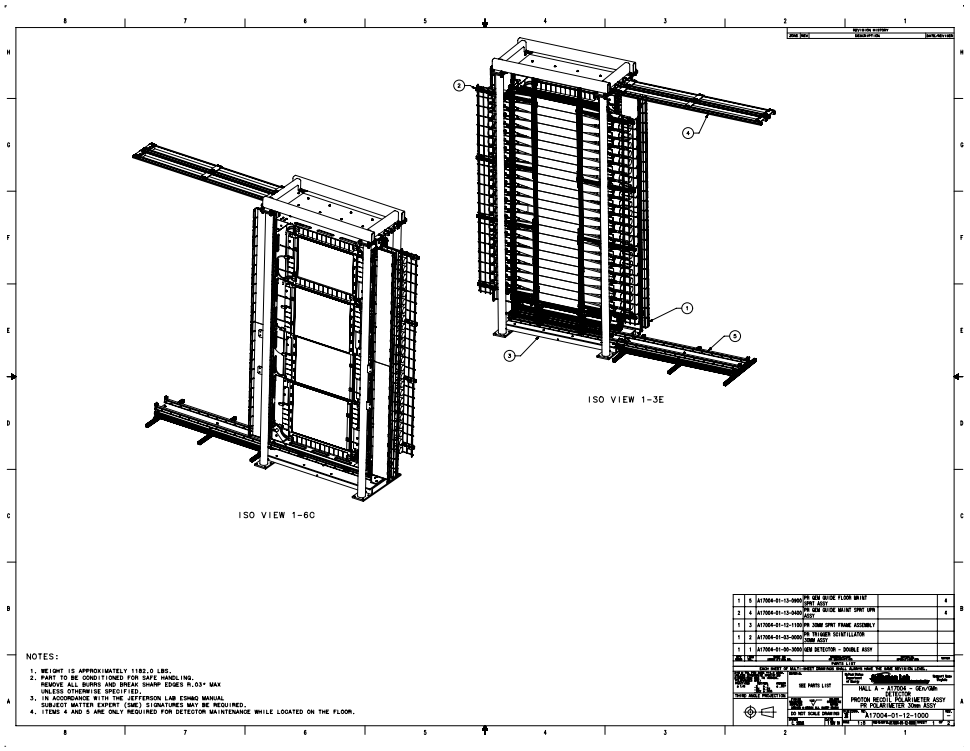

Figure 3: CAD model of one (beamline side) GEn-RP polarimeter side detector assembly. It contains UVa X-Y GEM layers and one 24 paddle hodoscope array. The second side detector is a mirror image. The rail extensions shown in this image are used only for installation or repairs, and are removed for production. The two UVa X-Y GEM layers are on a single rail mount, and the hodoscope array is on a second rail mount.

The hodoscope arrays in the two Side Detector assemblies are composed of 24 scintillator bars arranged in a vertical layer. Each scintillator bar is read out by a PMT + base assembly attached to each end of every bar. These bases (96 in total) are powered through individually controlled negative HV inputs (< -2200V; -1300V typical) using RG-59 SHV cabling and connectors.

The HV is supplied using a CAEN SY4527 commercial high voltage power supply (3kV max), low current (3 mA max). The HV units are controlled using the standard Hall A HV GUI. Instructions and specific details of the SBS and GEn-RP High Voltage controls may be found on the SBS EPICS High Voltage Wiki [2] page. See Section 6 for additional details on risks, mitigation, and procedures associated with the High Voltage system.

HV channel assignments currently in effect are indicated in two files (`group_map` and `channel_map`) in detector specific directories under `/adaqfs/home/aslow/EPICS/HV/` when logged in as `aslow` to one of the adaq machines.

4.1 Installation/Deinstallation and the Rail System

Each Side Detector frame is designed to be moved/lifted with the dual GEM layers and the hodoscope layer already installed.

4.1.1 Checklist for Installation/Deinstallation of the Inline Frame

- Ensure all high voltage, signal, ground cables are *removed*.
- Attach protective guard panels to any accessible, exposed, GEM gas windows.
- Ensure that both the GEM layer and hodoscope layer sub-assemblies are secured on their rails using the pins and rail clamps.

4.1.2 Checklist for using Rail Assembly

Note: Only one layer may be rolled out at a time. This *must* be organized with the support of the System Owner and the Hall A Work Coordinator. Any individuals working on the SBS carriage must ensure they have appropriate Fall protection and/or other training as required. Follow signage and check with the Hall Work Coordinator if unsure.

- Ensure all high voltage to both GEM layers and the hodoscope layer in the Side-detector frame is OFF.
- Disconnect necessary signal, HV, and gas line cabling.
- Install the rail extension assemblies to the bottom and top rails for the layer to be worked on. Ensure they mate cleanly with the permanent rail both top and bottom and the extensions are secure.
- Remove the rail clamp and pin to allow the sub-detector assembly to move freely on its rail.
- Move the sub-detector assembly slowly and carefully, being sure to watch for any cables that may snag and/or contact gas windows of the adjacent GEM layers.

[2] https://hallaweb.jlab.org/wiki/index.php/SBS_EPICS#High_Voltage

5 Active Analyzer

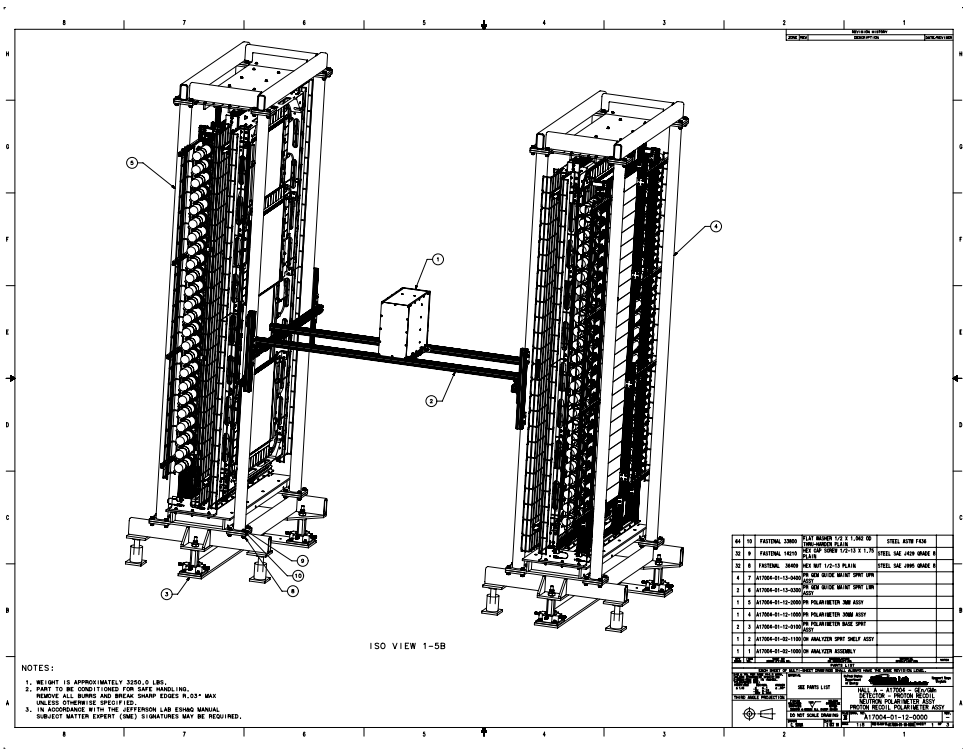

Figure 4: CAD model of the 32 scintillator Active analyzer array (box labeled "1") on its horizontal mounting bars. The horizontal mounting bars are attached to the left and right side detector assemblies. The Active analyzer is a self contained unit that can be hand-installed (or removed) by a single person in the position shown.

The "Active Analyzer" is composed of 32 scintillator blocks arranged in a 4 x 8 array. Each scintillator block is optically coupled to a photomultiplier (PMT) + base assembly. The "Active Analyzer" bases are powered through individually controlled positive high voltage (HV) inputs ($< +2000$V; $+1000$V typical) using RG-59 SHV cabling and connectors.

The HV is supplied using commercial high voltage power supplies (3kV max), low current (3 mA max). The HV units are controlled using the standard Hall A HV GUI. Instructions and specific details of the SBS and GEn-RP High Voltage controls may be found on the SBS EPICS High Voltage Wiki [3] page. See Section 6 for additional details on risks, mitigation, and procedures associated with the High Voltage system.

HV channel assignments currently in effect are indicated in two files (`group_map` and `channel_map`) in detector specific directories under `/adaqfs/home/aslow/EPICS/HV/` when logged in as `aslow` to one of the adaq machines.

[3] https://hallaweb.jlab.org/wiki/index.php/SBS_EPICS#High_Voltage

5.1 Installation/Deinstallation

Note: Installation/deinstallation of the Active Analyzer *must* be organized with the support of the System Owner and the Hall A Work Coordinator. Any individuals working on the SBS carriage must ensure they have appropriate Fall protection and/or other training as required. Follow signage and check with the Hall Work Coordinator if unsure.

The Active analyzer assembly is a self-contained unit weighing roughly 40 lbs. It can be installed/removed on its horizontal support rails by a single person.

6 High Voltage Supplies and Control[4]

All of the detector systems in Hall A use high voltages, from hundreds to several thousand volts, to either power photomultiplier tubes or maintain electric fields around sense wires in drift chambers or between GEM planes. These include scintillators, drift chambers, GEMs, scintillators, shower detectors, and Cerenkov.

6.1 Hazards

The personnel hazard with these devices is the high voltage. This qualifies as a Class I electrical hazard due to the supplies providing voltage >50 VDC with current limited to ≤ 5 mA.[5] This same hazard can damage phototubes if voltage is left on when tubes are exposed to room lighting.

6.2 Mitigations

- All user configurable high voltage cabling/patching is made with coaxial cables rated for high voltage with SHV connectors.
- High voltage shall be turned off before disconnecting (or connecting) high voltage cables from (or to) phototubes, power supplies or patch panels.
- High voltage shall be turned off and high voltage cables shall be removed from phototubes before handling phototubes or the detector elements they are used with.
- Current limits are set on power supplies to trip high voltage in case of shorts or shocks.
- External metal parts of detectors such as mu-metal shields are wrapped with electrical tape. Exposed metal parts are grounded through both the HV cable and signal cable grounds.

[4]Note: adapted from High Voltage section of Hall C Operations Manual.

[5]JLab ES&H Manual, Chapter 6230 - Appendix T1 - "Determining Equipment Class and Work Modes"

6.3 Responsible Personnel

The individuals responsible for the operation of the high voltage system are shown in Table 1.

Name (first,last)	Dept.	Call [1]		e-mail	Comment
		Office	Cell		
Brad Sawatzky	Hall-A/C	5947	757-344-2494	brads@jlab.org	
Jack Segal	Hall-A/C	7242	Web [2]	segal@jlab.org	

Table 1: Detector high voltage responsible personnel.

All the detector elements in the GEn-RP polarimeter require the use of High Voltage. The high voltage supply for the detectors are located in the main SBS DAQ bunker on the main floor of Hall A. It is connected to the detectors through coaxial cables with SHV connectors. During experiments the control of the high voltage supplies is done remotely via any of the computers in the the Hall A counting house.

As a general rule no work should be done on detectors which are under High Voltage and High Voltage cables should never be removed or installed while the supply is on.

6.3.1 High Voltage Configuration and Operation

The CAEN Distributed High Voltage System is responsible for providing high voltage power to all GEn-RP polarimeter PMT based detector systems. This system is a networked system made up of individual crates (Controllers) each of which can hold several independent high voltage modules (Cards). The crate associated with the GEn-RP polarimeter components is a SY4527 mainframe holding up to 8 cards with 24 SHV outputs each. (Other cards with different numbers of channels and different high voltage connector form factors are available, but only the described types are used here.) There are two flavors of cards in use with the GEn-RP polarimeter PMT detectors which are listed in Table 2.

The system is typically controlled through EPICS. Various methods of direct/local control are available for the two different crate types.

HV channel assignments currently in effect are indicated in two files (`group_map` and `channel_map`) in detector specific directories under `/adaqfs/home/aslow/EPICS/HV/` when logged in as `aslow` to one of the adaq machines.

Table 2: Specifications of SY4527 High-Voltage Cards used with the GEn-RP PMT detectors.

Card type	Max Voltage	Max Current	Detector System
A1535SN	–3500V	3.0mA	"Side detector" Hodoscope arrays
A1535SP	+3500V	3.0mA	"Active Analyzer"

General Operation

Normal Operation: In general the high voltage system will be controlled or monitored from the counting house using the EPICS slow control system. Operation of the EPICS graphical interfaces is described in the CAEN HV Operation Howto [3].

In case of a dead high voltage channel, the high voltage cable for a given detector element can be moved to a spare high voltage channel, if available. (The channel_map file, described above shows which channels are in use.) Care must be taken to always use the correct type of HV (positive vs. negative, vs. drift chamber supply). The procedure to make these changes is described in the CAEN HV Operation Howto [3]. Any changes in HV configuration shall be documented in the logbook.

For more complicated changes to the HV configuration, such as changing or adding HV cards or mainframes, consult and expert and the CAEN High Voltage System EPICS Controls Expert Howto [4].

Important Features: The user can program several important features for individual cards and/or channels. The most common are:

- HV limits – 2 types including a hardware maximum (common to a card) set with a pot on the front panel of each card and a software maximum for each channel.
- Current Trip Value – The current over which the system will indicate an alarm status and initiate a trip off of that channel.
- Current Trip Time – The amount of time the system will allow the alarm condition before actually switching off that channel.
- Ramp-up Value – The number of volts/sec the voltage will ramp to its set point upon switching on the channel.
- Other Features – See the CAEN Technical Information Manual.

Direct/Local Operation The SY4527 high voltage main frame can also be controlled through a web interface. These methods of control are described in the CAEN HV Operation Howto [3] and the vendor manuals for the SY403 [5] and SY4527 [6]. These modes of control are meant for diagnostics and testing of a detector system prior to running.

Safety Concerns/Caveats There are a number of cautions one should observe when operating the CAEN HV equipment to avoid damage and insure proper functioning:

- Use only proper SHV connectors and approved cables when connecting equipment to the supply.

- **DO NOT** attach/remove HV cables when loads are present on the channel (a red LED above each channel indicates the presence of a load).
- Insure adequate ventilation around crates to avoid overheating of the electronics.
- Wait 2-3 minutes after switching off a crate before removal of a HV card.
- Insure proper static precautions when handling HV cards.

6.3.2 High Voltage System Checkout

Before starting an experiment, or before using the high voltage system to test detectors, proper functioning of the HV supplies and EPICS controls should be verified with this checklist.

- Check EPICS: Using the EPICS Control system as described in the CAEN HV Operation Howto [3], verify that voltage set points and current/voltage limits are read by the control system.
- Verify Operation: For the detector(s) of interest, individually turn on each channel. Verify that the channel reaches the desired set voltage. If the readback voltage exceeds the set voltage by more than a few volts (Overvoltage), or fails to reach full voltage (Undervoltage), immediately turn off the channel, report the observation in the logbook and consult an expert.
- Verify Limits: Make a backup of HV settings. For each channel in the detector, set a current limit below the current being drawn by the detector channel. Verify that each channel trips. Similarly, set a maximum voltage for each channel below the set point and verify that the voltage limit is enforced. (This may change voltage set points, so they may need to be restored from backup.) Consult an expert if any channels fail to trip on overcurrent or if maximum voltage is not enforced.
- Interlocks: If any high voltage systems are interlocked with other systems, verify that assertion of the interlock signal turns off high voltage.

7 References

References

[1] Jefferson Lab, (12000 Jefferson avenue, Newport News, VA 23606). URL https://www.jlab.org/. Telephone numbers: (757)-269-XXXX. 8

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By signing this page, you testify that you have read, understand, and agree to abide by the procedure specified in the above referenced work control document:

Serial Number: ENP-21-119371-OSP

Title: GEN-RP SBS Polarimeter Detectors

Name	Signature	Date