CONDUCT OF OPERATIONS MANUAL DYNAMIC COMPRESSION SECTOR (DCS)

Washington State University

A DOE/NNSA SPONSORED USER CAPABILITY
At the Advanced Photon Source
Sector 35

APPROVED BY THE APS SAFETY COMMMITTEE ON FEBRUARY 25, 2021

UPDATED ON APRIL 10, 2024

AVAILABLE ONLINE AT: dcs-aps.wsu.edu/dcs-safety-training-information

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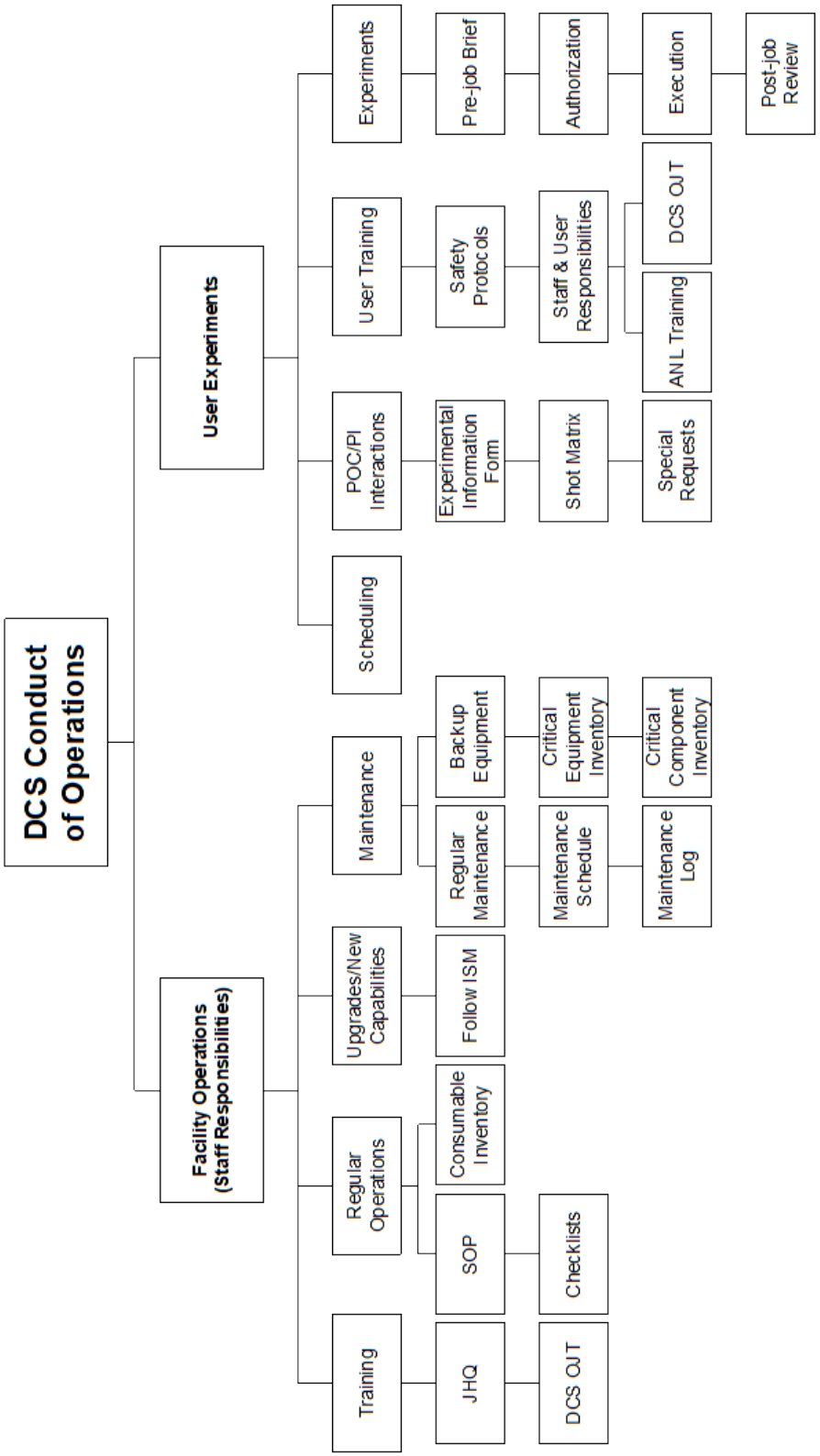


Figure 1. Overall structure of the DCS Conduct of Operations Model

1.0 PURPOSE

The Dynamic Compression Sector (DCS), sponsored by the National Nuclear Security Administration (NNSA) of the Department of Energy (DOE), is a first-of-its-kind capability dedicated to dynamic compression science. The DCS, located at the Advanced Photon Source (APS), links a broad range of dynamic compression platforms to a dedicated x-ray beamline to achieve *in-situ*, real-time, multiscale measurements during shock compression/release. Washington State University operates the DCS and led the effort to develop and build the DCS experimental capabilities and instrumentation, in collaboration with the Advanced Photon Source (APS); DOE/NNSA National Laboratories (Los Alamos, Lawrence Livermore, and Sandia); Army Research Laboratory; and the University of Rochester's Laboratory for Laser Energetics (LLE). The DCS represents a novel and visionary capability in support of the NNSA's scientific and programmatic missions and offers an opportunity to pursue fundamental science that has not been possible at other synchrotron facilities to date.

The purpose of this manual is to define the process and policy for Conduct of Operations for work activities conducted at the DCS. Conduct of Operations is a philosophy of working in a formalized, disciplined manner to achieve operational excellence that requires a commitment to maintain the highest standards of quality. Figure 1 shows the overall flow of this document.

Compliance to this Conduct of Operations is compulsory. Any individual failing to conform to the policies herein may be subjected to disciplinary (HR) actions and/or loss of access to the APS and DCS facilities and may result in suspension of DCS operations.

2.0 SCOPE

The DCS operations are complex and diverse. They require a high level of professionalism and formality to maintain safe, reliable, and efficient operations for both the DCS staff and the users. A principal focus of this document is to ensure that DCS staff are not overburdened with responsibilities that detract from their primary responsibility of operating and maintaining the DCS as a premier user facility. This is achieved by setting forth strict policies that govern operational parameters (such as hours of operation) and well-defined staff and user roles and responsibilities to ensure the long-term sustainability of the DCS Science and Technology mission.

Changes to this document must only be made with the approval of the DCS Principal Investigator or the DCS Manager with primacy in that order and shall be communicated to all relevant DCS and APS personnel. The DCS staff will communicate policy changes to users of the facility.

Changes to Attachments can be made with the approval of the DCS Safety Coordinator, who shall consult with the DCS Safety Committee.

3.0 REFERENCES

All facilities within the DOE complex shall establish formal Conduct of Operations in accordance with DOE O 422.1, "Conduct of Operations". This document follows the formatting guidelines adopted by the DOE for formal operating procedures and policies, the "Procedure Writer's Manual – PPA AP-907-005" (supersedes DOE-STD-1029.92 as referenced in DOE O 422.1). The structure and

content follow the general guidance established in the "Advanced Photon Source Conduct of Operations Manual" and was written using the graded approach described therein.

All activities at Argonne National Laboratory (ANL) will conform to the requirements of the documents listed below, except as provided for by variances or APS procedures. All of the following are available through the DCS Safety Coordinator.

a. Argonne Laboratory Management System (LMS) PROCs
b. APS User Policies and Procedures
c. ANL Hoisting and Rigging Manual (Hoist-1.0.1)
d. ANL Transportation Safety Manual (NWM-TSD-101 and NWM-TSD-TSR-101)
e. APS Hazardous Material Transportation (APS User Policies and Procedures Policy 3.1.34)
f. ANL Waste Handling Guide (PROC 446202)
g. ANL Electrical Safety Manual

4.0 ACRONYMS AND DEFINITIONS

4.1 Acronyms

2SLGG	2-Stage Light Gas Gun
ANL	Argonne National Laboratory
APS	Advanced Photon Source
AR	Acceleration Reservoir
CAT	Collaborative Access Team
CORAL	Chemical Ordering, Reporting, and Attributes Library
DCS	Dynamic Compression Sector
DCS PI	Dynamic Compression Sector Principal Investigator (Dr. Yogendra M. Gupta)
DOE	Department of Energy
DOT	Department of Transportation
ELOG	Electronic Logbook
EM	Energetic Materials
ES&H	Environment Safety & Health
ESAF	Experimental Safety Assessment Form
IFS	Impact Facilities Supervisor
ISM	Integrated Safety Management

JHQ	Job Hazard Questionnaire
LCA	Laser Control Area
LMS	Laboratory Management System
LOM	Lab Office Module
LOTO	Lockout/Tagout
LSO	Laser Safety Officer
OJT	On the Job Training
OSHA	Occupational Safety and Health Administration
PI	Principal Investigator (user)
PIC	Person-in-Charge (DCS)
POC	Point-of-Contact; can be either DCS POC or Lab POC
PPE	Personal Protective Equipment
PROC	Procedure
PSC	Photon Sciences Directorate
SOP	Standard Operating Procedure
SWAA	Satellite Waste Accumulation Areas
TOBB	Target-mounted Optical Beam Block
TMS	Training Management System
VISAR	Velocity Interferometer System for Any Reflector
WMS	Waste Management System

4.2 Definitions

a. **Acceleration Reservoir (AR)**: High pressure transition section between the pump tube and the launch tube.

b. **Breech:** Part of the first stage of the 2SLGG launcher. Contains the smokeless powder charge.

c. **Catch Tank:** Large tank located behind the target chamber used to catch debris and increase tank volume

d. **Catch Plates:** Plates hanging in the catch tank to absorb energy from projectile and debris after target impact.

e. **CORAL:** Argonne online chemical inventory database.

f. **DCS POC:** Dynamic Compression Sector Point of Contact: Primary DCS staff member assigned to be the liaison between the DCS and the CAT institutions. Currently the DCS Safety Coordinator.

g. **ESAF:** An online form the User PI completes, identifying all hazards and hazardous materials to be used in their upcoming experimental time at the APS. The form is reviewed and approved by both the APS and DCS prior to posting and the experiment beginning.

h. **Lab POC:** Point of Contact assigned at the CAT institutions to be liaison between their institution and the DCS.

i. **Launch Tube**: Second stage barrel of a 2SLGG. Holds the projectile that is launched by the compressed gas from the pump tube/AR sections.

j. **Post-job Review:** Review held after an experiment or series of experiments with all parties involved to discuss any issues that arose during execution.

k. **Pre-Job Brief**: Mandatory meeting held with all parties involved before an experimental series begins.

l. **Pump Tube:** First stage barrel of a 2SLGG. Holds the piston and light gas that the piston compresses on its way to the AR.

m. **Target Chamber:** Forward vessel on the impact platforms that house the target holder and target.

5.0 ROLES & RESPONSIBILITIES

5.1 Safety Organization Structure

The structure of the DCS Safety Organization and the personnel assignments are provided in Attachment 2. Safety Assignments. The specific responsibilities of each member of the DCS Safety organization are outlined in the following text. The DCS Principal Investigator has line responsibility for all safety aspects of DCS activities. At the same time, the success of the DCS safety and environmental protection effort depends on the shared commitment of all the DCS personnel.

5.2 Safety Organization Responsibilities

5.2.1 DCS Principal Investigator

The DCS Principal Investigator has the ultimate responsibility for ensuring that safe practices are implemented by the DCS Manager, DCS Safety Coordinator, and Staff. These responsibilities include ensuring that the DCS Manager and Staff are complying with all aspects of this policy.

5.2.2 DCS Manager

The DCS Manager has responsibility for all safety and environmental protection aspects of the DCS operations activities at the APS. The DCS Manager shall be responsible for ensuring that this plan is implemented, and for evaluating and responding in a graded manner to nonconformances with this plan and reports to the DCS Principal Investigator. The DCS Manager has the authority to delegate safety matters to the other members of the DCS as deemed appropriate. The DCS Manager shall make the APS Management aware of any safety or environmental protection issues that require the APS attention. The DCS Manager shall designate, as needed, the individual safety coordinators, captains and custodians. However, in exercising their particular safety duties, they shall report to the DCS Safety Coordinator.

The DCS Manager shall have the primary day-to-day responsibility for maintaining safe conditions in all spaces occupied by the DCS at the APS. This responsibility includes ensuring that the work performed by the DCS members, users, and on-site contractors providing services under the DCS auspices remains in accordance with the provisions of this program. The Manager shall work closely with the DCS Safety Coordinator in identifying and resolving safety and environmental issues involving DCS personnel at the APS. The Manager shall have the authority to stop any DCS activity judged to be unsafe or environmentally unsound. Additionally, the Manager shall be responsible for calling for and overseeing ES&H related sector reviews as requested by the APS Safety Organization.

5.2.3 DCS Safety Coordinator

The DCS Safety Coordinator shall be responsible for implementing and overseeing conformance with this Conduct of Operations. The DCS Safety Coordinator shall ensure that DCS personnel have access to the ANL LMS PROCs, the other documents referenced in Section 3.0, and the APS User Policies and Procedures in order to assist DCS members and users in meeting the requirements of these standards.

The DCS Safety Coordinator shall be responsible for the safety, neatness, and orderliness of all DCS operation activities conducted at the APS. The Safety Coordinator shall work with the APS and APS Safety Committees, and the PSC Safety Manager, and the DCS developers and contractors to create safe procedures pertaining to the beamline operation and other day-to-day safety requirements. The DCS Safety Coordinator shall be responsible for filing an ES&H Incident Report to the DCS Manager and to the PSC Safety Manager should violations of safe procedures and/or abnormal events occur. The DCS Safety Coordinator also shall be responsible for reviewing proposal forms for safety-related issues.

The DCS Safety Coordinator shall be the Chairman of the DCS Safety Committee which shall be composed of at least the Impact Facility Supervisors, Laser Facility Supervisor, Chemical Safety Coordinator, Electrical Safety Coordinator, and Transportation Safety Coordinator.

During the operations phase, the DCS Safety Coordinator shall coordinate Experimental Safety Reviews, and shall have the responsibility of reviewing all Experimental Safety Review Forms associated with all activities to be carried out in connection with experiments on the DCS beamline, including activities in the LOM laboratories assigned to DCS.

5.2.4 Person-In-Charge (PIC)

The PIC shall be the single person – as appointed by the DCS Manager – that has ultimate authority during a specific operation and/or experiment. The Standard Operating Procedure for each DCS operation shall clearly define who shall be the PIC and shall specifically define the responsibilities of the PIC.

The role of PIC must be suitably reassigned in situations including, but not limited to:

a. Shift-changes
b. Staff breaks
c. Unexpected emergencies

Policies regarding shift changes for all DCS staff, including the PIC, are covered in Section 8.6.

If any staff member or user feels uncertain or uncomfortable with the PIC designation, they have the right and the responsibility to utilize stop work authority until such concerns are alleviated. Staff or users may notify the DCS manager of any concerns regarding the PIC roles and responsibilities.

5.2.5 Impact Facility Supervisor (IFS)

The Impact Facility Supervisor for the Impact Facility will be responsible for maintaining a safe working environment and ensuring that only qualified and approved personnel configure and operate the impact-drivers. The Impact Facility Supervisor will ensure that day-to-day operations follow all approved Impact Facility Operating Procedures listed in Attachment 3: DCS Standard Operating Procedures.

The Impact Facility Supervisor shall understand the DOE safety manual DOE-STD-1212-2012 (June 2012) as they apply to operations at the DCS. The Impact Facility Supervisor must possess a valid Illinois explosives license and shall be conversant with all safety and security precautions as described in Part 200 of the Illinois Explosive Act.

The Impact Facility Supervisor shall review all safety aspects of proposed experiments that may affect the safety envelope of the facility.

5.2.6 Magazine Keeper

Magazines shall, at all times, be in the charge of a competent person, known as the magazine keeper,

who is at least 21 years of age, possesses a valid Illinois explosives license and is conversant with and will be responsible for the enforcement of all safety and security precautions as described in Part 200 of the Illinois Explosive Act. The current business and residence addresses and telephone numbers of the magazine keeper shall be on file with the Department of Natural Resources at all times.

The magazine keeper is responsible for seeing that the magazine is operated and maintained in accordance with Part 200 of the Illinois Explosive Act and that all reports and records are made and kept in accordance with Subpart I of the Act. The holder of the certificate may designate additional magazine keepers.

All magazines containing energetic materials shall be inspected at least every 7 calendar days to determine whether there has been an unauthorized entry or attempted entry into the magazines; or to determine whether there has been unauthorized removal of the magazines or their contents. This inspection does not require a physical inventory unless there is evidence of unauthorized entry or removal.

The Magazine Keeper shall be responsible for ordering energetic materials and work with the Transportation Safety Coordinator for the sector to ensure its safe delivery to ANL. The magazine keeper shall provide a semiannual inventory of on-site energetic materials (EM) with disposal plans and notices of when EMs are removed from the site.

5.2.7 Chemical Safety Coordinator

The DCS Chemical Safety Coordinator shall be responsible for assisting in all areas of chemical safety, including the identification of the proper procedures for the handling of chemicals and gases. The Chemical Safety Coordinator shall ensure the use of the ANL Chemical Management System (CORAL, Chemical Ordering, Reporting, and Attributes Library replaced CMS & WMS) and the Hazardous Waste Management System (WMS) and shall ensure compliance with ANL and OSHA chemical safety standards within the DCS facilities as well as EPA and RCRA regulations.

The Chemical Safety Coordinator shall help ensure that safety items and protective equipment stocked by DCS are appropriate for the work being performed and the materials being handled.

The Chemical Safety Coordinator shall review the chemical safety aspects of proposed experiments upon the request of the DCS Safety Coordinator.

If an inspection or review activity lies outside the Chemical Safety Coordinator's area of expertise, the Coordinator shall seek assistance from other DCS personnel having the proper expertise. If no such person is available, assistance shall be sought from the APS.

5.2.8 Electrical Safety Coordinator

The DCS Electrical Safety Coordinator shall be responsible for assisting in all areas of electric safety and for ensuring compliance with ANL electrical safety standards in all of the DCS facilities. The

Electrical Safety Coordinator shall be aware of ANL Electrical Safety Manual requirements as typically attained through completing ANL Qualified Electrical Worker training.

The Electrical Safety Coordinator shall have the responsibility for ensuring that electrical utilities records are maintained for the sector and the LOM areas assigned to the DCS. Upon request, the coordinator shall also review temporary electrical installations for safety and ensure that ANL lockout/tagout requirements for electrical work are met.

The Electrical Safety Coordinator shall review the electrical safety aspects of proposed experiments upon the request of the Safety Coordinator.

If an inspection or review activity lies outside the Electrical Safety Coordinator's area of expertise, the Coordinator shall seek assistance from the DCS personnel having the proper expertise. If no such person is available, assistance shall be sought from the APS.

The Electrical Safety Coordinator shall be a QEW and shall complete ESH414, ESH414P, and ESH414PR as a minimum requirement.

5.2.9 Laser Control Area Supervisor

The Laser Control Area (LCA) Supervisor is also responsible for documentation and safety issues associated with the laser systems at the DCS. It is anticipated that the specific needs of the DCS Users will change as experiments are conducted and the facility matures, and that the LCA Supervisor will ensure that these demands are safely met in accordance with ANL policy.

Authorized Laser Users, who are permanent Sector staff, will be developing, operating, and maintaining these laser systems. However, the LCA Supervisor shall inspect and authorize all laser setups. At the discretion of the LCA Supervisor, “laser only” experiments or tests not requiring x-rays may also be conducted in an LCA.

The LCA Supervisor or Deputy LCA Supervisor must:

a. Determine and select the lowest power laser needed for the job.
b. Notify the site ANL Laser Safety Officer (LSO) or deputy of plans to acquire, borrow, fabricate, relocate, or modify an existing laser installation. Consider the recommendations from LSO or deputy regarding power level, engineering controls, eyewear, hazard zone computations, and specifications in advance of procuring a laser.
c. Upon receipt of a laser, notify the LSO or deputy.
d. Prepare, or assign the preparation of, any local procedures for safe use of lasers (LMS-Proc-285 Laser Safety) using LMS-PROC-200, *Local Work Planning and Control Implementing Procedures*.

5.2.10 Laser Facility Supervisor

The Laser Facility Supervisor shall be responsible for the maintenance and safe operation of the 100J Laser System and ensuring that only qualified and approved Laser Operators configure and operate

the laser system. The Laser Facility Supervisor will ensure that day-to-day operations follow all approved Laser Operating Procedures listed in Attachment 3: DCS Standard Operating Procedures.

5.2.11 Laser Operator

A Laser Operator is a member of the DCS staff who has been trained by the Laser Facility Supervisor and authorized by the DCS PI to operate the 100J Laser System.

5.2.12 Transportation Safety Coordinator

The DCS Transportation Safety Coordinator shall be responsible for assisting with all issues regarding the safe transportation of materials to and from the DCS facilities at ANL and ensuring compliance with ANL transportation safety standards. The Transportation Safety Coordinator shall be aware of ANL transportation requirements, APS specific shipping and receiving requirements, and shall remain current in the APS transportation safety course.

The Transportation Safety Coordinator shall review the transportation safety issues related to proposed experiments upon the request of the Safety Coordinator.

If an inspection or review activity lies outside the Transportation Safety Coordinator's area of expertise, the Transportation Safety Coordinator shall seek assistance from the DCS personnel having the proper expertise. If no such person is available, assistance shall be sought from the APS.

5.2.13 Hoisting and Rigging Coordinator

The Hoisting and Rigging Coordinator shall be responsible for ensuring that records of rigging equipment are maintained for the DCS facilities. The Coordinator shall satisfy the training and qualification requirements specified by ANL for incidental crane operators, and shall review training records of personnel, approve individuals to perform rigging operations and maintain a list of all trained individuals at DCS facilities.

The Hoisting and Rigging Coordinator shall review equipment brought to DCS facilities and shall approve it for use at DCS facilities. The Coordinator shall be responsible for arranging for storage of rigging equipment, and the completion of crane and sling inspections according to the ANL LMS PROCs. The Coordinator also shall review rigging procedures for non-standard operations and, when appropriate, shall recommend the use of ANL professional riggers.

If an inspection or review activity lies outside the Rigging Coordinator's area of expertise, the Coordinator shall seek assistance from the DCS personnel having the proper expertise. If no such person is available, assistance shall be sought from the APS.

5.2.14 Machine Shop Coordinator

The Shop Coordinator shall be responsible for overseeing the machine shop located in Sector 35 (35-ID-MS) in order to maintain a safe, neat, and orderly operation. The Shop Coordinator shall ensure

that all ANL requirements for operating shop equipment are met and that monthly inspections of all machines to ensure that they are operating properly are completed.

Users of the shop must demonstrate that they can safely operate a particular machine before the Shop Coordinator grants approval to use that machine. Certification for use of shop equipment shall be obtained from the APS. A list of qualified operators shall be posted in the shop.

5.2.15 Laboratory Safety Captain

The Laboratory Safety Captain shall be responsible for overseeing the laboratory space located in the LOM and Sector in order to maintain a safe, neat, and orderly operation. The Captain shall have the responsibility for ensuring that all aspects of the DCS safety program are properly administered and documented in the assigned laboratory. Safe operating procedures for facilities and apparatus within the laboratory space shall be maintained and the Laboratory Safety Captain shall be responsible for training in these and related procedures. The Captain shall have the authority to stop activities in the laboratory which the Captain feels are unsafe or environmentally unsound. If such action is necessary, the Captain shall report the activity to the DCS Manager. Each DCS Laboratory and Experimental Hutch has been assigned a Laboratory Safety Captain (refer to Attachment 2. Safety Assignments).

5.2.16 User

A User is a scientific collaborator who may participate in a DCS experiment in a limited way, such as inserting and removing targets and limited cleaning operations. The actions and the safety of a user while participating in an experiment are the direct responsibility of the PIC. All users will need to comply with the policies and procedures outlined in this Manual and follow the PIC's instructions during the conduct of their experiments. See Section 8.9.3.

6.0 PRECAUTIONS AND LIMITATIONS

None.

7.0 PREREQUISITES

None.

8.0 OPERATIONS

8.1 General Policies

a. All DCS activities must comply with the current version of the APS Policy and Procedure for configuration control of shielding systems. Safety systems under configuration control shall not be modified without the DCS and the APS approval. (Refer to the APS User Policies and Procedures for the complete policy and procedure).
b. The DCS shall cooperate with the APS to facilitate the oversight responsibilities of the APS, ANL and the DOE.

c. Experimenters shall submit an ESAF at least 14 days prior to their assigned experimental time clearly identifying the hazards and materials to be used in experiments at the DCS. No work shall commence until this ESAF has been approved by the DCS Manager and APS and posted by the APS Floor Coordinator.
d. No piece of equipment shall be used outside its safety design parameters.
e. If an activity can adversely impact anyone working at the APS, or the facilities of the APS or any other APS Sector, the plans shall be reviewed and approved by the Associate Laboratory Director (ALD) for Operations, or designee.
f. All shipments of energetic materials to the DCS will be in accordance with the Department of Transportation (DOT), local ANL policies, and DOE safety manual DOE-STD-1212-2012 (June 2012), or its successor.

> All energetic materials used to accelerate the impactors in the various impact-drivers will consist only of smokeless powder that is commercially available.

g. Chemicals brought to the DCS should be limited to the smallest reasonable quantities necessary for the work to be performed. Any individual bringing chemicals must inform the DCS Chemical Safety Coordinator to ensure that they are logged in the Argonne chemical inventory database (CORAL). Unless special arrangements are made with the DCS Manager, DCS shall not be responsible for storing surplus chemicals.
h. The DCS shall implement Suspension of Work Authority and Stop Work Authority in accordance with ANL policy LMS-POL-1.

8.2 Suspension of Work Authority

Personnel conducting any activity at the DCS are authorized to temporarily cease, or suspend, their own work to immediately correct a deficiency or unsafe condition that does not pose an immediate danger to themselves, other workers, the public, or the environment. Examples of circumstances under which a worker may suspend work include but are not limited to: damage to personal protective equipment during the course of work, housekeeping issues, minor facility deficiencies, or minor chemical spills. Workers may also suspend work if something unusual or unanticipated occurs and they need to take time to evaluate the situation and decide what to do (this scenario may result in a decision that no change or correction is required). Workers may restart suspended work without seeking authorization from the DCS Manager.

8.3 Stop Work Authority

All DCS staff, visitors, facility users, and contractors are empowered and obligated to stop any activity that they deem to pose an immediate danger to themselves; other workers, visitors, users, or contractors; the public; or the environment. This authority is referred to as “stop work authority.” Individuals who exercise stop-work authority also are obligated to immediately report their action to the DCS Manager. The DCS Manager will then report the stop work to the DCS PI and APS Management, as appropriate.

After an individual has stopped work as described above, work may not resume until the DCS Manager has verified that appropriate hazard control measures are in place and that the individual who stopped the work has had the opportunity to concur with the corrective action. (Note that APS Management may require a readiness assessment or operational readiness review before work is resumed after an individual has exercised stop work authority.)

This stop work policy must be communicated to all DCS staff and users of the facility before work may begin.

8.4 Hours of Operation

Experiments conducted at DCS are complex and require trained DCS staff to be present (in most cases) to operate the equipment and instrumentation. DCS dynamic compression drivers, and X-ray and optical instrumentation require considerable expertise and training. The DCS website houses the current work schedule designed to balance safety, user needs, and staff productivity that DCS personnel follow.

Each shift shall consist of at least three DCS staff members with balanced skills. Support from the DCS Manager and Administrative Staff will be available from 8am to 5pm Monday through Friday. These hours will be followed primarily while plate impact experiments are being conducted in the D and E stations and laser shock experiments in the C station. Current hours of operation allow DCS to be available to users seven days per week with extended work hours on five of those days. Any changes to the hours of operation shall be posted on the DCS website.

8.5 Use of Equipment and After-Hours Operations

Safe and efficient operation of all DCS facilities is of primary importance and the responsibility of the DCS staff. Once the hours of operation have been established for a particular Run or experimental series, those hours will be communicated to the user. Use of facilities and equipment located at DCS outside of these hours (when DCS staff is not present) will not generally be allowed. The following exceptions to this rule may be negotiated:

a. Members of the NNSA laboratories can use the DCS detector systems after hours, once safe and proper operation of the equipment has been demonstrated to the DCS Manager.
b. Users who bring and set up their own equipment may use that equipment after hours provided they have demonstrated safe operation of the said equipment to both the DCS Manager and APS safety (the second criteria is met when the user's Experimental Safety Assessment Form is approved by APS).

Equipment brought to and left at DCS must be made available to all users under the following condition: Either members of the DCS staff or the user have been trained to use the equipment safely and properly by the equipment owner (Memorandum of Understanding (MOU) required).

8.6 Shift Changes/Turnover of Operations

Staff shift changes – including changes in the PIC – shall follow the guidelines below. Communication between shifts shall be made verbally if the shifts overlap (i.e. mid-day change) or by email if shifts do not overlap (i.e. end-of-day or weekend shifts) to all participants.

a. Shift changes will occur in between experiments whenever possible.[1]
b. Shift changes within an experimental sequence will occur between sections of the appropriate experimental checklist.
c. The retiring shift and new shift will discuss the status and location of all control keys.
d. The retiring shift and new shift will discuss the status of the relevant experimental checklist.
e. The retiring shift and new shift will discuss any recent issues with the experimental platforms being used (i.e. drivers, detectors, etc.)
f. The personnel roles will be updated on a highly visible display board in the control area nearest the experiment being performed as soon as the shift change occurs.
g. If a staff member must leave campus due to an emergency, they will notify any staff or user encountered on their way out of the building.
h. The day's shift schedule will be discussed during each daily brief session.

8.7 Ozone Mitigation Plan

At the DCS, it is not practical to contain the entire x-ray beam in evacuated beam transport tubes. Due to the diversity of configurations needed for DCS experiments, sections of the x-ray beam will be allowed to propagate through air in each station. Thus, ozone production – due to the interaction of the unshielded white beam with oxygen in the atmosphere – is possible in each experimental station at the DCS.

Several steps are taken to mitigate ozone production during normal operations. First, the white beam is chopped using a mechanical device that produces 22 μs bursts of x-rays at 83 Hz. Under these conditions, the average power entering a station is <1.3 Watts. Production of ozone in this mode is unlikely.

Longer x-ray exposures (several to 10s of milliseconds) are needed for most dynamic compression experiments conducted at the DCS. Therefore, the length of exposed beam will be kept to the minimum practical for a given experiment to minimize ozone production.

Finally, ozone meters are installed to measure the ozone concentration in the station. If the ozone concentration reaches 0.2 ppm, the beam will be turned off and no access will be allowed into the station until the ozone concentration falls below 0.2 ppm. Between 0.05 and 0.2 ppm, access of less than 1 minute may be granted by the PIC to turn on a fan, for example.

[1] Due to the complexity of DCS experiments, it will not always be practical or possible to make a shift change between experiments.

It should be noted that – during that last five years of operation – no ozone production has been detected during any regular operation.

8.8 Facility Operations (Staff Responsibilities)

8.8.1 Training

8.8.1.1 ANL Training Requirements

All DCS personnel shall have a completed and approved Job Hazard Questionnaire (JHQ) that accurately reflects their job responsibilities as defined by the DCS Manager. Personnel shall be responsible for taking all required training as indicated in the ANL Training Management System (TMS), which is directly linked to their JHQ, on or before the expiration date. Personnel shall not conduct any work for which the required training is expired. JHQ's are required to be reviewed annually and revised accordingly.

8.8.1.2 DCS Training Requirements

DCS has developed an On-the-Job Training (OJT) program for any personnel designated as an IFS. Personnel given IFS responsibilities must complete this program as outlined in "On-the-Job Training (OJT) for the Dynamic Compression Sector Launchers and Smokeless Powder Operations".

8.8.2 Regular Operations

8.8.2.1 Routine DCS Activities

Routine activities include all light laboratory activities and are conducted under the purview of Document Number 19202.4 "Facility Hazard Analysis." All staff shall be required to attend a pre-job brief after starting at DCS before performing any hands-on work in the laboratories. A pre-job brief shall be held for all DCS staff once per year.

8.8.2.2 Machine Tool Operation

Machine tools (lathe, milling machine, and band saw) may only be operated by authorized personnel under the purview of Document Number 49814.0 "Machine Tool Operation". Personnel must receive a pre-job brief by the Machine Shop Coordinator upon becoming an authorized user before work can begin. The Machine Shop Coordinator shall hold a pre-job for all authorized users once per year.

8.8.2.3 Standard Operating Procedures (SOPs)

All SOPs shall conform to the DOE standards and follow the DOE Style Manual and be reviewed every three years per APS policy. Proposed changes to SOPs shall be presented, in writing, to the DCS Manager. The DCS manager or designee, following Integrated Safety Management (ISM) principles shall draft a revised SOP document that reflects the proposed changes. All signees of the SOP shall provide their approval of all changes before the revised SOP is submitted to the PSC Safety Manager for approval.

Attachment 3: DCS Standard Operating Procedures contains a full list of SOPs describing the procedures for safe operation of the drivers and diagnostics tools used to conduct dynamic compression experiments at the DCS.

8.8.2.4 Checklists

Checklists shall be created for operation of each DCS platform and shall be included as an attachment to the appropriate SOP.

During shot execution, critical final steps shall require that instructions are first spoken to all participants and will require responses in the affirmative from all participants before moving on to the next step. See the individual SOPs for each operation for the specific steps that require this procedure.

Checklists may be updated as needed with approval from the DCS Safety Coordinator. Completed checklists shall be kept on file (either hardcopy or electronically) at the DCS for a period of 1 year.

8.8.3 Upgrades/New Capabilities

Upgrading current capabilities and developing/implementing new capabilities is a key element in maintaining any user facility. The ISM process shall be followed for any such activities at the DCS. This will include an implementation plan – approved by the DCS Manager – with the following elements:

a. Scope of work
b. Hazard analysis
c. Development and implementation of controls
d. Work tasks (including pre-job brief and post-job review)
e. Feedback and implementation of improvements from post-job review

8.8.4 Facility and Equipment Maintenance

All facilities and equipment shall be regularly maintained according to a written maintenance schedule approved by the DCS Manager. A logbook (written or electronic and accessible to all staff) shall be kept for any maintenance – regular or otherwise – performed on any DCS equipment. Equipment found out of spec/tolerance or in some way malfunctioning shall be taken out of service immediately and clearly labeled “Out of Service. DO NOT USE”. The label shall include the name of the person who took the item out of service and the date that it was done, and relevant details of this action shall be recorded in the logbook and reported to the DCS manager immediately. For equipment that could potentially expose personnel to hazardous energy, a request must be made to the floor coordinator to Lockout and Tagout the equipment (LOTO) until proper repairs can be made.

The DCS Manager shall maintain critical equipment and component inventories at all times with an electronic record of backup equipment and components on-hand. These inventories shall be stored on the DCS server and made accessible to the DCS Administrative Staff as well as the DCS PI.

8.9 User Experiments

All users are required to have an Argonne User Facility Agreement in place before performing any work at the DCS. If a User Facility Agreement does not exist between a user's home institution and Argonne, then the user must request that one be created. More information – including a list of existing User Facility Agreements – can be found on the APS website.

8.9.1 Scheduling

The DCS will utilize the APS Beam Time Access System to receive all proposals for experimental time at the DCS (CAT and General User).

Because of the unique challenges in creating a user schedule for the DCS, the schedule shall be created one Run ahead of the normal APS schedule. For example, the submission deadline for Run 1 of any calendar year for other APS sectors shall correspond to the deadline for Run 2 (of that same calendar year) submissions for DCS Users.

The DCS Manager will create a schedule that maximizes efficiency and productivity for all user experiments. The schedule created shall be considered final once distributed to all PIs (CAT and General Users) and the PIs shall be expected to be available for their allocated beam time. Each PI shall be expected to confirm in writing to the DCS Manager that they can utilize the experimental time allocated to them within 7 business days. If no response is obtained within this time or the PI has informed the DCS Manager that the time, as allocated, cannot be utilized, then the time shall be considered forfeit and will be reassigned to another user.

8.9.2 DCS/PI Interactions

Each PI who is allocated experimental time at the DCS shall be assigned a DCS Point-of-Contact (POC) from the DCS Staff to work directly with to finalize all experimental details in advance of their allocated time. The DCS shall provide the PI with an Experimental Information Form and Shot Matrix (see Attachments 4 and 5 for impact experiments) to be filled out and returned to the DCS. Table 1 is an approximate schedule for interactions with respect to allocation of experimental time.

Table 1. Timeline for DCS/PI interactions. Due Date is with respect to start of PI experimental time at the DCS

Action	Owner	Due Date
Request Experimental Information Form and Shot Matrix from PI	DCS	-10 weeks
Special requests submitted to DCS POC	PI	-10 weeks
Decision on special requests	DCS Mgr.	-9 weeks

Return Experimental Information Form and Shot Matrix to DCS	PI	-9 weeks
Request all users complete outstanding DCS/APS training (1 reminder will be provided by DCS)	DCS	-8 weeks
Ensure all components are available for PI experiments	DCS POC	-4 weeks
Send user-supplied impactors to DCS	PI	-4 weeks
Submit ESAF*	PI	-3 weeks
Experimental Conference Call	DCS/PI	-2 weeks
User Team completes all outstanding DCS/APS required training (PI is accountable for user team)	PI	-1 week
All target hardware (including optical probes) and projectiles ready	DCS POC	-2 days
Provide on-site specific training to all new users and users with expired training	DCS POC	-1 day
ESAF reviewed, signed, and posted	PI/APS Floor Coordinator	-1 day (of first day of lab work)
Provide pre-job brief to all users	DCS POC	Start of Day 1
Prep and communicate with DCS Admin on return shipping	PI	Final Day
Provide post-job brief to all users	DCS POC	End of Final Day
Return DCS Feedback Form (prompted via email)	PI	+1 week

8.9.3 User Expectations and Responsibilities

Users are expected to conduct themselves in a professional manner at all times while at the DCS and/or interacting with the DCS staff. In addition, users are expected to:

- Provide requested information to the DCS POC in accordance with Table 1 (Section 8.9.2).
  - Failure to provide information on this timeline will negatively affect the user's allocated time up to and including cancellation of experiments

- Arrive one day before the start of their experimental time:
  - With prepared targets
  - To receive a pre-job brief from the DCS Staff
  - To finish final assembly of all targets
- Keep work/office spaces tidy and put tools away after use.
- Suspend or stop work when warranted (see Sections 8.2 and 8.3)
- Respect the authority of the PIC and DCS staff
  - PIC may terminate an experiment and/or activity at any time if he/she deems the operation unsafe or infeasible in the time remaining during normal operating hours.
  - PIC may choose to extend normal operating hours at the user's request provided that there is unanimous agreement from all participating DCS staff.
  - Users shall not ask the DCS Technical Assistants to assist with any activity without consulting with the PIC first.
  - Users shall not compromise safety for productivity. Putting pressure on DCS staff and coworkers to "rush," "pick up the pace," or "cut corners" to accomplish more experiments will not lead to increased overall efficiency and can lead to decreased safety of operations. Any abuse of this policy will be immediately brought to the DCS Manager's attention and appropriate actions – including termination of an experimental series and loss of user privileges at the DCS – will be taken.
- Attend post-job review once the final experiment has been completed.
  - Discuss any issues that should be addressed for future users.
  - Provide additional feedback that could be helpful for future operations.

8.9.3.1 User Participation Guidelines for Impact Experiments (Stations D and E)

In addition to the expectations outlined above, users will be expected to participate in their own DCS impact experiments in a limited way. The lists below are representative, but not all inclusive.

Users shall:

a. Finish final assembly of all targets including installation, inspection, and optimization of optical probes using Class 2 lasers in F030 (ESH 121, Low-Power Laser Safety recommended).
b. Bundle all optical fibers, as instructed, to aid with target installation

Users shall not:

a. Open hutch door post-shot
b. Enter hutch without IFS supervision when retractable barrier is up
c. Perform any maintenance (including inspecting, cleaning, connecting, or disconnecting) on optical fibers in the D and E Stations
d. Operate any class 3b or 4 lasers

e. Attach target chamber side flange pre-shot
f. Close catch tank door pre-shot
g. Open catch tank door post-shot
h. Remove target chamber side flange post-shot
i. Breach and/or remove the catch tank door fiber barrier
j. Operate LabVIEW controls
k. Change x-ray settings

Users may:

- Perform single-person search of hutch.
- Assist in cleaning Pump Tube, AR, Launch Tube, Target Chamber, Catch Tank, and Breech Components in accordance with instructions located in control room
  (1) Safety glasses and nitrile gloves must be worn at all times
- Clean target chamber side flanges (once removed from target chamber) (safety glasses required)
- Clean catch plates (once removed from the catch tank) (safety glasses required)
- Install targets onto target holder. Perform target alignment (x-ray burns and corresponding gun movement) and alignment of target-mounted beamstops
- Operate X-ray detector software (Lightfield) to take ambient images
- Install debris collimator tubes
- Use Pb tape with proper PPE (safety glasses, nitrile gloves)
  (1) Must be properly disposed of in SWAA

Attachment 7. Experimental Campaign Structure provides a brief guide to the user for the flow of a typical experimental campaign at the DCS, while Attachment 8. XRD Impact Experimental Flow Diagram provides a flowchart for a typical user impact experiment using x-ray diffraction as the diagnostic tool.

8.9.3.2 User Participation Guidelines for Laser Shock Experiments (Station C)

Experiments in the laser shock station are fundamentally different than in other stations. Users will be expected to provide fully assembled target wheels on the day their experimental time starts. Additional hands-on work in this station by users is not permitted.

8.9.3.3 User Participation Guidelines for Special Purpose Experiments (Station B)

Highly specialized experiments are conducted by individuals in B hutch and require little help from the DCS Staff once the initial setup is complete. See Attachment 9. Conduct of Operations for 35-ID-B Users for more information.

8.9.4 User Training

APS and DCS Training is required of all users. Training consists of online courses and onsite sector orientation. All training must be completed and current to use the DCS Facility. It is the responsibility of the PI to ensure that all users have completed all online training before arriving at the DCS. Onsite Sector Orientation will be provided by DCS Staff upon arrival (Section 8.9.4.2). Access to the DCS labs and experimental stations will not be allowed unless all training is complete and the ESAF is posted. In addition, a pre-job brief (Section 8.9.4.3) is required before work commences in any DCS experimental station.

8.9.4.1 ANL User Training Requirements

All users are required to complete the online APS User Training prior to arriving onsite at DCS. A list of current and expired APS training courses for each user can be found on the submitted ESAF.

8.9.4.2 DCS Sector Orientation

All users shall be made aware of the DCS safety protocols such as Suspension of Work Authority (Section 8.2) and Stop Work Authority (Section 8.3) and what to do in the event of an emergency during their Sector Orientation (see below). Additionally, users shall be reminded of these protocols during each visit to the DCS during their pre-job brief (see Attachment 10. DCS Sector Orientation Materials).

All users are required to complete the online DCS Sector Orientation and read and understand the DCS Conduct of Operations prior to arriving onsite at DCS. Upon arrival, DCS staff will provide its own onsite Sector Orientation to all staff members and users, in accordance with the APS Policy and Procedure for Sector Specific Training. The DCS Sector Orientation Materials include the following: DCS Conduct of Operations Manual, a safety brochure, safety checklist and printed copy of the experimental hutch search pattern diagram for all experimental stations.

Onsite Sector Orientation will be given to all staff and users, after their arrival at the sector and before the start of their work, if one of the following is applicable:

a. User is a new user of the DCS facility
b. It has been two years since the staff or user's last Sector Orientation
c. Significant changes have been made to the DCS facilities, policies, and/or procedures since the user's last visit to the sector

8.9.4.3 Pre-Job Brief

All users will be required to attend a pre-job brief conducted by the DCS staff. This briefing will be held on the day before or the morning that their allocated experimental time begins during normal business hours (8-5 Sunday through Saturday). See Attachment 11. Pre-Job Brief. This form shall be completed once for each experimental series (i.e. all experiments conducted under one ESAF shall require at least one Pre-Job Brief before *any* work within the DCS facilities may commence) and the user will be asked to sign acknowledging that they have received the briefing.

Please note the following stipulations:

a. The pre-job brief shall be given only once on the day before the user's experimental time begins.
b. All users participating in the experiments are expected to attend at the pre-arranged time.
c. Any user who does not attend the pre-job brief shall not be allowed to perform any work within the DCS experimental stations.
d. If the PI requests that a user, who has not attended the pre-job brief, be allowed to assist with experiments, then work during that PI's allocated time shall be suspended in order to provide *all* participants with the pre-job brief again and a new acknowledgement page shall be completed by all attendees.

8.9.4.4 Authorization

The PI will be required to review the ESAF with an APS Floor Coordinator before the ESAF can be posted and work can begin, including DCS OJT. Final authorization to perform any work (other than office work) at the DCS is granted *only* after the ESAF has been posted.

8.9.4.5 DCS User Training Requirements

Users shall be provided OJT for the following activities:

Impact Experiments

a. TOBB optimization
b. TOBB to target measurement
c. Velocimetry probe integrity check
d. Velocimetry probe installation
e. VISAR probe optimization
f. Final target assembly
g. On-target beam stop alignment

In addition, users will work with a DCS staff member during final setup and execution of each experiment.

Laser Shock Experiments

a. Final target assembly

8.9.5 Post-Job Review

All users will be required to attend a post-job review with the DCS staff once the final experiment has been conducted. If the users will not be at the DCS the day following their last experiment, then the PIC will end experiments at least one hour early on the last day to ensure time is available before the end of the last day. Notes shall be captured during the review and be made available to all attendees within 1-2 days after the meeting takes place. Note that this shall not replace the end of experiment feedback as described below.

8.9.6 End of Experiment Feedback

The forms in Attachments 13. Staff Feedback Form and Attachment 14. User Feedback Form shall be sent to the DCS staff and users, respectively, to request feedback after each experimental series has been completed. Feedback on these forms is meant to provide candid comments to the DCS Manager about any issues that occurred during the experimental series. The DCS Manager will review all feedback and take appropriate action to address issues in a timely manner. Anonymous comments are always welcome by submitting comments to the APS user office with an explicit request for anonymity.

ATTACHMENT 1. DCS PERSONNEL WITH EXPERIMENT SAFETY APPROVAL AUTHORITY

As the DCS Principal Investigator, I authorize the following personnel to conduct hazard evaluations of experimental activities, to specify required control measures, and approve such activities where specified controls have been implemented. (Upon updating this form, DCS will provide a copy of the revised form to the PCS Safety Manager).

Name	**Email Address**
Paulo Rigg	prigg@wsu.edu

Dr. Yogendra M. Gupta
DCS Principal Investigator

10/12/2018
Date

ATTACHMENT 2. SAFETY ASSIGNMENTS

Assignment	Person assigned
Principal Investigator	Yogendra M. Gupta
DCS Manager	Paulo Rigg
Safety Coordinator	Adam Schuman
Person-in-Charge (list of personnel authorized to act as PIC)	Drew Rickerson (Impact Experiments) Robert Zill (Impact Experiments) Paulo Rigg (Impact Experiments) Adam Schuman (Laser Shock Experiments) Nicholas Sinclair (Laser Shock Experiments) Yoshi Toyoda (Laser Shock Experiments) Pritha Renganathan (Laser Shock Experiments)
Impact Facility Supervisors	Drew Rickerson Robert Zill Paulo Rigg
Magazine Keepers	Drew Rickerson Robert Zill
Chemical Safety Coordinator	Robert Zill
Electrical Safety Coordinator	Xiaoming Wang
Laser Control Area Supervisors	Xiaoming Wang (100J Laser) Adam Schuman and Paulo Rigg (All other Class 3b and Class 4 lasers)
Laser Facility Supervisor (100J Laser)	Xiaoming Wang
Laser Operator	Nicholas Sinclair
Transportation Safety Coordinator	Liz Prokop
Hoisting and Rigging Coordinator	Robert Zill
Machine Shop Coordinator	Drew Rickerson
Laboratory Safety Captains	438/F012 – Nicholas Sinclair

	438/F012W – Xiaoming Wang 438/F016 – Drew Rickerson 438/F020 – Robert Zill 438/F030 – Drew Rickerson 35-ID-IR – Adam Schuman 35-ID-PR – Robert Zill 35-ID-B – Nicholas Sinclair 35-ID-C – Xiaoming Wang 35-ID-D – Robert Zill 35-ID-E – Drew Rickerson
APS ESH Representative	Paul Rossi

ATTACHMENT 3. DCS STANDARD OPERATING PROCEDURES

The following SOPs are currently in use at the DCS:

a. **DCS-OJT-001** – On-the-Job Training for the Dynamic Compression Sector Launchers and Smokeless Powder Operations
b. **DCS-SOP-001** – Standard Operating Procedures for Smokeless Powder and Primer Preparation
c. **DCS-SOP-002** – Standard Operating Procedures for the 35-ID-D Single Stage Gas Gun (SSGG)
d. **DCS-SOP-003** – Standard Operating Procedures for the 35-ID-D and 35-ID-E Powder Gun (PG)
e. **DCS-SOP-004** – Standard Operating Procedures for the 35-ID-E Two-stage Light Gas Gun (2SLGG)
f. **DCS-SOP-005** – Standard Operating Procedure for the DCS 100J Laser System (35-ID-LR)
g. **DCS-SOP-006** – Standard Operating Procedures for the 100J Laser Power Conditioning Unit (PCU)
h. **DCS-SOP-007** – Standard Operating Procedures for Laser Controlled Area Building 400, Sector 35 Rooms 35-ID-D and 35-ID-E
i. **DCS-SOP-008** – Standard Operating Procedures for Laser Controlled Area Building 400, DCS Instrumentation Room 35-ID-IR, 35-ID-B, 35-ID-C, 35-ID-D, and 35-ID-E

ATTACHMENT 4. EXPERIMENTAL INFORMATION FORM PLATE IMPACT EXPERIMENTS

Experimental Overview	
Experiment Title	
Experiment Dates	
Lead Experimenter (Name, Institution, Phone, E-mail)	
Other Experimenters:	Email Address:
Scientific Objective	
Number of experiments required to achieve scientific objective	
List of Material(s)	
Experiment Parameters	
Configuration: Undulator and Multilayer Monochromator (MLM)	☐ U27, 36 keV with MLM (standard for XRD) ☐ U17.2, 24 KeV, 1st harmonic with MLM ☐ U17.2, 26 KeV, 15 mm gap, 1st harmonic (standard for PCI) ☐ U27, 23 keV without MLM Other: _____
Experiment Type	☐Imaging Detector Magnification (FOV): ☐5x (2.5mm) ☐ 7x (1.7mm) ☐10x (1.3mm)
	☐Diffraction Scintillator Size: ☐75mm ☐120mm ☐150mm

	Beam Position on Detector: ☐Center ☐Edge ☐Other:
Diffraction Geometry	☐Reflection Gun Angle: Detector Angle:
	☐Transmission Gun Angle: -28˚ Detector Angle: 0˚
Is target rotation about the barrel axis needed? (±10° range of motion)	☐Yes ☐No
X-ray spectral scan required?	☐Yes ☐No
Beam size at target *[Usual size for expt. at D and E hutches – 300 horiz./800 vert. (μm)]*	Horizontal (μm): Vertical (μm):
Timing Trigger:	☐PZT ☐TOBB
Target/probe configuration *(POC provide DCS standard target design)*	☐Standard DCS ☐User-provided design
Velocimetry: ☐User supplied probes Describe probes:	☐VISAR (1 probe) Available VPFs (m/s/fringe) (select two) ☐72 ☐95 ☐181 ☐308 ☐458 ☐945
	☐PDV Number of Channels:
Detail of issues from last DCS visit:	

Required Target and Configuration Detail
1. Drawing of experimental configuration. The drawing must include the sample assembly, incident and outgoing x-rays, gun angle, detector plane, detector distance and the desired field of view. 2. Detailed drawing of the target assembly. It should identify the various target components and materials used. Please include any non-standard details or unusual requests in the diagram. Include any relevant distances/indicators to locate the sample position while aligning the sample using x-rays, for example sample edges/thickness and their distances from target plate/spacers) 3. For XRD experiments: **1.** If the sample has been previously studied at DCS, please provide ambient x-ray diffraction images (and dates of previous campaign). If not, have ambient diffraction pattern ready from other sources or from simulation.
Shipping Requirements
1. Review shipping requirements. If shipping materials in advance of your arrival date, provide shipment tracking numbers to dcs.admin@wsu.edu 2. Is your shipment greater than 50lbs or contains hazardous materials? ☐Yes ☐No 3. If yes, please provide your APS User Cost Code: PRJ # _____. 4. An APS User Account is required to pay for miscellaneous materials and services associated with your beamline experiments at the APS (i.e. APS Stockroom supplies, APS Riggers for transporting your shipments to/from the dock, or anytime an ANL service request is submitted, even if there is no accompanying cost). • Unsure of your APS User Cost Code or need to setup/maintain an APS User Account? Contact Lauren Ambrose at APS (630-252-1244, useracct@aps.anl.gov) Your APS User Cost Code must be established prior to your experimental campaign.

Publication Requirements

The Acknowledgment Statement must be included in manuscripts for the work conducted at the Dynamic Compression Sector and published in journals, books, conference proceedings, or other printed scientific and technical media.

Notification of accepted manuscripts require notification to DCS and APS. *Send the copyright-free version of accepted manuscripts* to dcs.admin@wsu.edu and enter your accepted manuscript into the APS Publications Database.

1. Provide detail of in-press or published manuscripts that include any previous work performed at DCS.
2.
2. DCS Users are expected to publish results in peer-reviewed journals within a reasonable period (~1 year) after scheduled user time. Please indicate the anticipated timeline for publishing the results from your upcoming DCS experiments.

User Requests/Information

Please communicate any additional experimental details, requests and/or concerns relevant to your experimental time.

ATTACHMENT 5. SHOT MATRIX FOR PLATE IMPACT EXPERIMENTS

The following is not the actual Matrix, but specifically shows the content DCS requests for each shot.

Priority	**Target ID (name)**	**Expected Shot Day**	**Gun (*)** PG/SSGG/2SLGG	**X-ray Config (**)**	**Expected Sample X-ray Transmission*** (%)**
Window Type	**Window Thickness (mm)**	**Sample Type**	**Sample Thickness (mm)**	**Impact surface to Target Plate (mm) (#)**	**Impactor Type**
Impactor Coated Yes/No	**Impactor Thickness mm**	**Desired Projectile Velocity (km/s)**	**Probe Layout Standard Yes/No**	**# of VISAR Probes**	**# of PDV Probes**
Sample Thickness (mm)	**Impact surface to Target Plate (mm) (#)**	**Impactor Type**	**Impactor Coated Yes/No**	**Impactor Thickness mm**	**Desired Projectile Velocity (km/s)**
Probe Layout Standard Yes/No	**# of VISAR Probes**	**# of PDV Probes**	**Sample Thickness (mm)**	**Impact surface to Target Plate (mm) (#)**	**Impactor Type**
Impactor Coated Yes/No	**Impactor Thickness mm**	**Desired Projectile Velocity (km/s)**	**Probe Layout Standard Yes/No**	**# of VISAR Probes**	**# of PDV Probes**

**DCS X-ray Configuration Options: Transmission XRD, Reflection XRD, PCI

*** See next sheet for calculating sample transmission

Impact surface to target plate distance on standard targets is brass spacer ring plus target plate thicknesses.

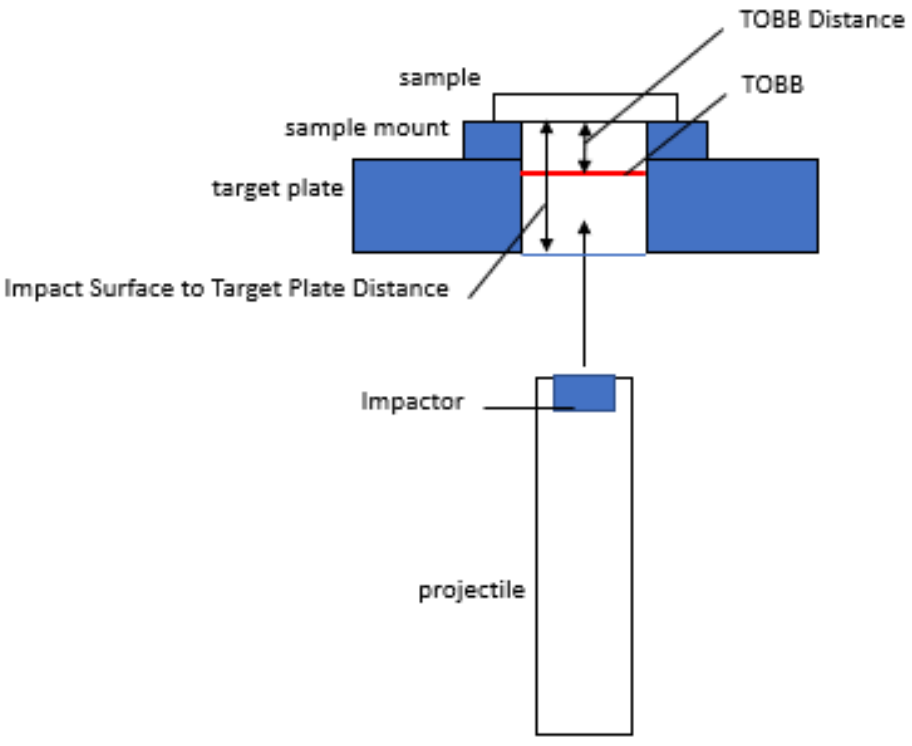
Impactor vs. Velocity Range (km/s)

Standard Impactors	SSGG (D)	PG (D/E)	2SLGG (E)
6061 Aluminum (0.5” Ø x sabot)	0.4 - 0.8	0.75 - 1.7	N/A
Polycarbonate (0.5” Ø x sabot)	0.5 - 1.0	1.0 - 2.6	3.5 - 6.5
TPX (0.5" Ø x sabot)	N/A	N/A	4.0 - 7.0
Tantalum (0.4” Ø x 4mm)	0.4 - 0.9	0.75 - 2.1	N/A
Copper (0.4” Ø x 4mm)	0.4 - 0.9	0.75 - 2.4	N/A
6061 Aluminum (0.4” Ø x 4mm)	0.4 - 1.0	0.75 - 2.5	N/A
1050 Aluminum (0.4” Ø x 4mm)	0.4 - 1.0	0.75 - 2.5	N/A
LiF (10mm Ø x 4mm)	0.4 - 1.0	0.75 - 2.5	N/A
LiF (9mm Ø x 3mm)	N/A	N/A	3.5 - 6.5

Attention:

Velocity ranges are approximate and subject to change over time.

Non-standard impactors can be accommodate with approval and must be provided to DCS at least 2 weeks in advance of experimental time.



X-ray Transmission Calculator

Target	Target Thickness (mm)	Window Material	Window Thickness (mm)	Gun Angle* (deg)	Effective Target Thickness (cm)	Effective Window Thickness (cm)	Target Material mu (cm^2/g)	Target Density (g/cc)	Target Atten Length (µm)	Window Material mu (cm^2/g)	Window Density (g/cc)	Target Transmission (%)	Window Trans. (%)	Total Trans. (%)
Al / LiF Example at 23.6 keV	1.5	LiF	2	-28	0.320	0.43	2.15E+00	2.699	1720.89	5.97E-01	2.635	15.62%	51.18%	8.0%

*0 = barrel perp to beam, -28 is standard transmission XRD config, + is for reflection XRD geometry
However, for this calculation, if gun angle == 0, enter gun angle = 90 and put in thicknesses along beam direction

** Mu can be found at XCOM from NIST: https://physics.nist.gov/PhysRefData/Xcom/html/xcom1.html
Use the 'Total Attenuation with Coherent Scattering'

ATTACHMENT 6. EXPERIMENTAL INFORMATION FORM
LASER EXPERIMENTS

Experimental Overview	
Experiment Title	
Experiment Dates	
Lead Experimenter (Name / Institution / Phone / E-mail)	
Other Experimenters: *Please limit onsite experimenters to two or less.*	Email Address:
Scientific Objective	
Number of experiments required to achieve scientific objective	
List of Material(s)	
Experiment Parameters	
Configuration: Undulator and Multilayer Monochromator (MLM)	☐ U17.2, 24 KeV, 1st harmonic with MLM (standard) ☐ U27, 36 keV with MLM ☐ U17.2, 24 KeV, 1st harmonic without MLM Other: _____
Detector distance from target:	Min: 97mm Requested: ____ mm
X-ray spectral scan required?	☐Yes ☐No

Beam size at target:	Beam will be focused on target Horizontal: 80 μm Vertical: < 50 μm
Target Design: **Users should calculate x-ray attenuation from the sample and window and optimize thicknesses accordingly. DCS can help with this, if needed.**	Range of Sample Thicknesses: _____ μm Ablator Thickness: _____ μm ☐Al-coated Kapton or ☐ Other:_____ Interferometry Window ☐ LiF ☐None ☐ Other:_____ Thickness: _____ mm
Velocimetry: Dual Line VISAR (Single Axis) and Dual Point VISAR	Standard Line VISAR VPFs: 2,068 & 1,160 m/s/fringe Standard Point VISAR VPFs: 1,554 & 748 m/s/fringe
Detail of issues from last DCS visit:	
Lab Access and Shipping Requirements	
If you request access to DCS laboratories and/or the machine shop, please specify your needs:	
Review shipping requirements. If shipping materials in advance of your arrival date, provide shipment tracking numbers to dcs.admin@wsu.edu	

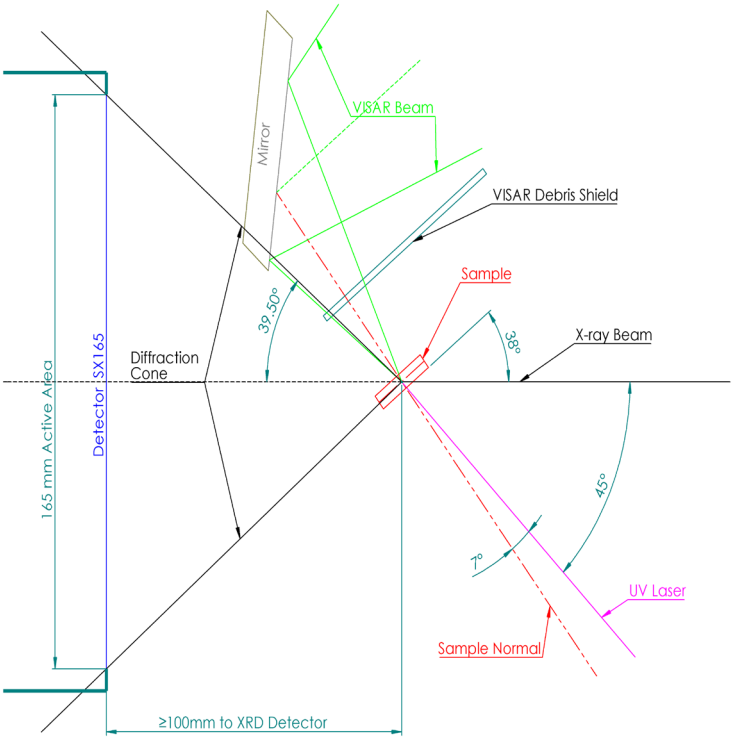
Publication Requirements

The Acknowledgment Statement must be included in manuscripts for the work conducted at the Dynamic Compression Sector and published in journals, books, conference proceedings, or other printed scientific and technical media. Notification of accepted manuscripts require notification to DCS and APS. Send the copyright-free version of accepted manuscripts to dcs.admin@wsu.edu and enter your accepted manuscript into the APS Publications Database.

A. Provide detail of in-press or published manuscripts that include any previous work performed at DCS.

B. It is the expectation that users submitting non-proprietary proposals will publish, based on any experimental work at DCS, to the open literature. What date do you anticipate an accepted manuscript and/or publication based on the results of your upcoming scheduled experimental time at DCS?

Configuration Diagram



Additional Requests/Information

The DCS Team welcomes any additional experimental details, requests and information (attached diagrams, descriptions) that will assist in the preparation for your experimental time.

ATTACHMENT 7. EXPERIMENTAL CAMPAIGN STRUCTURE

Users can expect their experimental campaign to be structured as follows:

Day 0 (at least one day before experimental campaign starts)

1. All users arrive on site and check in with DCS Admin team (M-F 8-5)
    a. Sector Orientation given to new users
    b. Post ESAF
2. Final Target Assembly in F030
    a. OJT for new users
    b. Stage all targets
    c. Complete Shot Request Forms and provide to IFS

Day 1 Experimental Campaign

1. Pre-job brief (all onsite users must be present, remote users - optional)
2. Experiments commence
    a. Experiments per day
        - SSGG: 6
        - PG: 5
        - 2SLGG: 4
        - Laser Shock: 16
    b. Users participate in impact experiments as shown in Attachment 8. XRD Impact Experimental Flow Diagram
    c. User do not participate (hands-on) in Laser Shock experiments

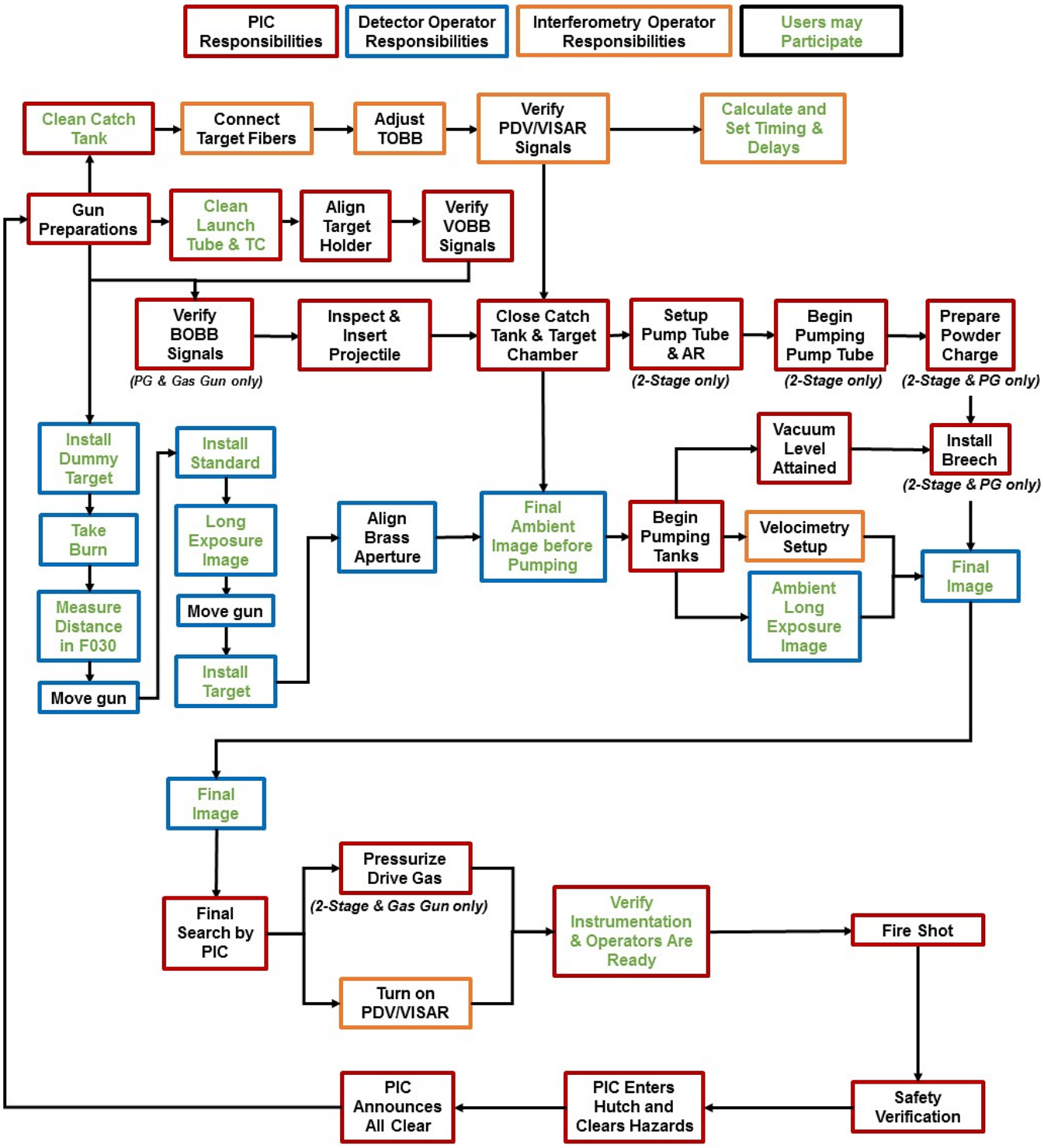
Continued Experimental Campaign Days

2. Daily brief at Start-of-Day
    a. Daily DCS personnel schedule
    b. Relevant information from prior day's experiments

Last Day of Experimental Campaign

1. Post-job review held one hour before End-of-Day
2. Users clean user area and fully prepare any return shipment items. Communicate all return details, including appropriate APS and shipping accounts, to DCS Administration

ATTACHMENT 8. XRD IMPACT EXPERIMENTAL FLOW DIAGRAM



ATTACHMENT 9. CONDUCT OF OPERATIONS FOR 35-ID-B USERS

1.0 INTRODUCTION

This document describes the conduct of operations for user experiments in the 35-ID-B hutch (B-hutch), the 'Special Purpose Hutch' at the Dynamic Compression Sector (DCS). The B-Hutch differs from the 35-ID-C/D/E hutches in that there is not a single, dedicated dynamic compression driver for the station. Instead, users bring outside equipment for dynamic experiments (typically compression drivers), and they work with DCS staff to integrate this with the x-ray beamline infrastructure. The difficulty of setting up new equipment during the limited scheduled beamtime can lead to the implementation of inadequate hazard controls. This risk must be mitigated with detailed planning. This planning requirement is formalized by requiring documentation from users prior to the start of their experiments, detailing how the experiments will be safely conducted.

Due to the flexible nature of this hutch, this document will not define specific operations or procedures. Instead, the objectives of this document are the following:

1. Define a general safety envelope for B-station users, establishing boundaries on authorized user activities
2. Define the required planning documents required from users before experiments will be authorized

At present, a DCS staff member must be present during all user activities in the B-station. This person will verify that hazard controls are appropriate for the real scope of work and that activities are limited to that which is authorized under the planning documents. This will require the hours of operation to be restricted by DCS staff availability.

2.0 LIMITS ON AUTHORIZATIONS GRANTED TO B-STATION USERS

Authorization for users to perform specific tasks will be defined in each experiment's operating procedure, which must be approved by DCS and APS. Here, tasks are listed which users will not be authorized to perform under any circumstances.

DCS users shall not be given authorization to:

1. Enter the 35-ID-A hutch to make changes to the X-ray optics configuration
   a. Limited, remote operation of optics components (e.g. focusing mirrors) may be authorized, with appropriate training, at the discretion of the DCS beamline scientists.
2. Use the overhead chain hoist in 35-ID-B
3. Perform any electrical work requiring 'Qualified Electrical Worker' status from Argonne

3.0 REQUIRED DOCUMENTS FROM USER

Users will be required to submit the following documents for approval by DCS and APS, prior to their experimental campaign. The required contents of these documents are described in subsequent sections.

1. Standard Operating Procedures (SOPs) individually covering all main experimental components (dynamic compression driver and/or other key equipment)
2. Conduct of Operations Manual, describing how operations will be conducted during the experiment
    a. Specific to the equipment used and measurements performed (e.g. XRD measurements on the Kolsky Bar)
    b. A previously approved document may be used if it encompasses the proposed experiment's scope of work
    c. SOPs and Conduct of Operations Manual must be received 4 weeks in advance of beam time
3. Experimental Campaign Plan, specific to a single scheduled beamtime
    a. Beamline configuration, personnel schedules, scheduled configuration changes
    b. Required at least 2 weeks in advance of scheduled beamtime. Modifications to the plan after this time may be allowed at the discretion of the DCS Manager

4.0 APPROVAL AND AUTHORIZATION PROCESS

4.1 Before beamtime:

a. Approval of SOPs by DCS and APS
b. Approval of Conduct of Operations by DCS
c. Approval of Experimental Campaign Plan by DCS
d. Approval of ESAF by DCS and APS

4.2 During beamtime

On-site review by DCS: DCS Manager, DCS POC, and DCS Safety Coordinator

1. Initial pre-job brief
2. Walkthrough of set-up plan
    a. Leading to authorization to begin set-up
3. Walkthrough of hutch after set-up completed
    a. Including verbal walkthrough of procedure and checklists
    b. Final check for adequate control of hazards
    c. Leading to authorization to begin experiments

5.0 GUIDE FOR STANDARD OPERATING PROCEDURES

A standard operation procedure should govern the operation of each of the main components of the experiment (gun, lasers, etc.). Operating procedures for Class 3B and 4 lasers must follow ANL LMS-PROC 285. All procedures must contain the following elements (or equivalent):

1.0 Cover page with title
2.0 Header containing:
    2.1 Title
    2.2 Document number
    2.3 Revision number
    2.4 Page number (Page X of Y)
3.0 Approval Page
4.0 Revision History: Summarize changes since last revision
5.0 Table of Contents

The sections to be included are as follows:

1.0 Purpose – Describe the overall purpose of the Conduct of Operations document.
2.0 Scope – Define the scope of work. This should cover all work that may be performed.
3.0 References – include any references to procedures or other documents made throughout the document.
4.0 Acronyms and Definitions – include if appropriate.
5.0 Roles and Responsibilities: Define the personnel roles required for operations and their individual responsibilities.
6.0 Training requirements: Indicate the training requirements for the roles described above.
7.0 Description of Equipment, with schematics appropriate to understand operation.
8.0 Hazards: Define all unmitigated hazards and the consequences to personnel if exposed to each hazard.
9.0 Controls: Separate the control of individual hazards into sub-sections and specifically describe the following:
    9.1 Required Personal Protective Equipment (PPE).
    9.2 Engineering Controls.
    9.3 Administrative Controls.
10.0 Operating Procedures. Consider including the following sections:
    10.1 Prerequisites: Requirements for starting procedure.
    10.2 Pre-shot: All instructions leading up to shot or measurement.
    10.3 Post-shot: Instructions for clean-up and reset (if appropriate).

11.0 Control of Emergencies and Abnormal Situations (failure of gun to fire, explosives did not detonate, etc.).

Attachments to the SOP shall include:

1.0 List of Authorized Users.
2.0 Signature page: Signed by all authorized users with the following verbiage: "I affirm that I have read and understand this procedure and all procedural steps, and I agree to operate within the stated constraints."
3.0 Required Documentation such as maintenance logs and checklists.
4.0 Any additional information useful to the authorizers for approval of the procedure.

6.0 GUIDE FOR CONDUCT OF OPERATIONS DOCUMENT

While a standard operating procedure outlines the operation of a single piece of equipment, the Conduct of Operations document describes how these procedures are integrated. The primary purpose is to address how operations will be conducted safely, without harm to personnel or major equipment.

As this document describes the real scope of proposed work, this should be the primary document encompassing all safety requirements. This document may refer to SOPs when these documents cover the full scope of operation in the integrated experiment. For example, if the gun hazards and hutch-specific controls are the same as listed in the SOP, that SOP may be simply referenced in the Conduct of Operations, Hazards section.

The Conduct of Operations document should be organized into the following structure, developed to follow DOE's five Integrated Safety Management Core Functions. The DCS Conduct of Operations Manual shall serve as a useful guide.

Note that, depending on the complexity of the operations proposed, a single document that encompasses the elements of the SOP above and the Conduct of Operations below may be sufficient. Please discuss this with the DCS manager before proceeding.

6.1 Conduct of Operations Document Structure

1.0 Purpose – Describe the overall purpose of the Conduct of Operations document.
2.0 Scope – Define the scope of work. This should cover all work that may be performed.
3.0 References – include any references to procedures or other documents made throughout the document.
4.0 Acronyms and Definitions – include if appropriate.
5.0 Roles and Responsibilities: Define the personnel roles required for operations and their individual responsibilities.

5.1 Should cover all roles defined in the SOPs as well as any specific to the integrated experiment.

5.2 Multiple roles may be covered by a single person, if appropriate. Staffing requirements should be described in Section 8: Operations.

6.0 Precautions and Limitations – if none, simply write "None" in this section.

7.0 Prerequisites – list any steps that must be completed before work can begin. If none, simply write "None" in this section.

8.0 Operations:

8.1 Operational Hours and Staff:

8.1.1 Any limitations on hours of operation, length of shifts.

8.1.2 Minimum staffing levels for each shift (necessary to cover all roles).

8.2 Person-In-Charge (PIC):

8.2.1 At all times, one PIC shall be assigned with the sole authority to determine if experiments may proceed.

8.2.2 Describe formal hand-off when a change of PIC occurs (i.e. at the beginning of a new shift).

8.3 Pre-Job Brief:

8.3.1 Remind team of Safety First / Stop Work Responsibility, and requirement to call 911 in an emergency.

8.3.2 Remind team of experimental limitations, PPE requirements, and any guidelines for safe operations.

8.3.3 Discuss Roles and Responsibilities.

8.3.4 Abbreviated pre-job brief shall be given at the beginning of each shift.

8.3.5 If operating in shifts, describe how this briefing occurs for each shift.

8.3.6 See Attachment 11. Pre-Job Brief, for an example Pre-Job Brief for Gun Operations.

8.4 Checklists:

8.4.1 All administrative hazard controls (e.g. key control) must be contained in a checklist.

8.4.2 Checklists should contain hold points before hazards are introduced (laser enabled, shot fired, etc.). At these points, second-person verification of any administrative controls is required before proceeding. The Person-In-Charge (PIC) Role should complete the checklist, and the Verifier Role should be established in Section 1.2. The DCS staff member present during the experiments may be assigned the Verifier role, if appropriate.

8.4.3 The following checklists are suggested, and they may be required if unique hazards occur at these times:

8.4.3.1 Setup

8.4.3.2 Start of Day

8.4.3.3 Pre-Shot

8.4.3.4 Post-Shot / Clean-up

8.4.3.5 End of Day

8.4.3.6 Tear-down

8.4.4 During the beamtime before operations begin, DCS Staff will verbally walk through these operations with the PI to evaluate the hazard controls.

8.4.5 Revision Control: Changes to processes affecting safety during an experimental campaign will require resubmission and reapproval of the ESAF. If changes are made in between experimental campaigns, please inform the DCS Manager of said changes when submitting a new ESAF.

9.0 Review of operations: A formal procedure should be described here to review operations after work has begun. A brief post-shot meeting of the participants is recommended to gather feedback on whether things are operating as expected or if revisions are needed to the procedures.

7.0 REQUIRED CONTROLS FOR SPECIFIC HAZARDS:

7.1 Laser light

All requirements outlined in LMS-PROC 285 must be met. For an overview, see the table, Exhibit C Laser Control Methods, in that document. Accessible light from Class 3B and Class 4 lasers should be avoided. If necessary, e.g. during initial alignment, the following will be required for DCS approval:

1. Requirements of LMS-PROC 285
    a. ANL training, including OJAT by LCA Supervisor
    b. All required controls (E-stops, laser warning lights, etc.)
2. Detailed procedure for all exposed beam operations, including safety checklist with second-person, concurrent verification of critical steps for hazard control
3. Approval of each laser operator's qualifications by DCS Manager

Work performed on fiber optics that may be connected to laser sources must have rigorous controls to avoid eye exposure when performing fiber inspection, maintenance, or initial installation. Work on fiber optics (disconnection, inspection, cleaning) that may be connected to a laser source must be performed by an authorized laser operator under the active laser SOP.

7.2 Heavy objects

Anyone working with, or around, unsecured heavy objects must be wearing steel-toed shoes. This includes the use of pallet jacks to reconfigure the hutch tables. DCS staff can assist with this.

8.0 GUIDE FOR EXPERIMENTAL CAMPAIGN PLAN

The experimental campaign plan document lays out the specific plan for the scheduled beamtime. This includes configuration of the hutch and beamline, personnel schedules, and assistance required from DCS staff. While a majority of this document is related to logistics, the campaign plan will be evaluated by the DCS Staff Point-of-Contact (POC) for consistency with the safety plan described in the Conduct of Operations.

The following items should be detailed.

- Daily Work Schedule: Who will be present and when
- Hutch Configuration: General description is fine:
  (1) What tables are needed (e.g. motorized?) and where should they be placed?
  (2) Items to be installed, e.g. extra JJ slits, beampipes up to gun, etc.
- Beam configuration(s):
  (3) X-ray energy of interest?
  (4) Which Undulator (U27 or U17)?
  (5) Focused?
    - Specify focal position in hutch
    - Which mirror stripe (Pt, Rh, Si)
  (6) What x-ray shutters are necessary? (Galv. shutter, ms-shutter, high heat load chopper)
    - How will they be synchronized with the event of interest (e.g. projectile impact)?
- Required DCS equipment
  (7) DCS Detector?
  (8) Electronics (Delay generators, oscilloscopes)
- What needs to be shipped to DCS and when can we expect it?
  (9) Does anything need to be inspected by us on arrival?
- When are specific DCS Staff members needed?
  (10) Schedule for configuration changes (e.g. if changing undulators)
  (11) Need an x-ray spectral scan? When should it be done?
- Timing: What electrical trigger signals do you need to synchronize your equipment with x-ray shutter openings and the individual x-ray bunch arrival?
  (12) e.g. TTL trigger to detector 2 microseconds before x-ray arrival, driving 50Ohm load

ATTACHMENT 10. DCS SECTOR ORIENTATION MATERIALS

SECTOR ORIENTATION RECORD

Stand in LOM. Welcome them to DCS. Hand out the DCS Safety Training Brochure located by the front desk.

① **Affirmation and clarification of the safety first and stop work principle:**

Impress upon them that APS/ANL and DCS DO take safety seriously and they must also. Inform them that if they see someone doing something they believe is not safe, they should ask him/her to stop. If the worker refuses to stop, direct them to find Paulo. If Paulo is not present, direct them to find another DCS team member and have them call Paul Rossi.

② **Orientation to the DCS environmental, safety, & health plan**

Show safety plan and Conduct of Operations Manual (located at the front desk). They should have read it in its entirety for understanding before coming to the DCS. No sign-off until read. Conduct of Operations Manual is on the Safety Training Information page on DCS Website

Explanation of the DCS general policies pertaining to control of hazards

DCS has a standing Safety Committee. MANY people have safety responsibilities. "Users of the DCS facilities are individually responsible for both their own safety and that of colleagues affected by their actions."

No sandals (open-toe shoes) or shorts are allowed on the experiment hall floor or in the labs.

Introduction to the DCS Safety Coordinator and the DCS Manager and an affirmation of the importance of bringing all safety and environmental problems and concerns to their attention

Go down the list of Safety Personnel on 1st page of DCS User Safety Training Brochure and point out Adam Schuman's office as the Safety Coordinator and Paulo Rigg's office as the DCS Manager.

Tell users to ask ANY safety-related question or request information and PPE from ANY staff member, rather than trying to find out which staff member is responsible for what. The staff member will direct the question to the appropriate person.

Summarize by saying, we take your safety very seriously. It is not worth risking injury. We have gloves, safety glasses, etc. Whatever you need, we will get it for you to work safely.

③ Location of safety equipment (fire extinguisher, shower, eyewash station, etc.)

Show location and remind them of how to use shower & eyewash

438F F020 Eyewash only

438F F030 Shower and eyewash

Inform them to see administrative coordinator for access to first aid kit in administrative desk drawer.

Show target prep area (hood and bench area)

Point out flammables cabinet.

Safety glasses must be worn at all times and are available on the wall by the door.

Safety documentation (including SDSs), safety and waste procedures

We log all hazardous chemicals using the online ANL CORAL (Chemical Ordering, Reporting, and Attributes Library).

Tell them that we must store all large quantities of flammables, reagents in proper places.

SDSs (Safety Data Sheets) are maintained for all materials stored in the Chemistry Lab.

SDSs information can be found online in the ANL CORAL.

Tell them to contact Chemical Safety Coordinator to obtain chemical tags to be completed for all stored chemicals.

Disposal of waste, including hazardous waste

Absolutely nothing should be disposed in common trash cans or the sink except "kitchen chemicals", common soaps or general waste. All other waste must be appropriately packaged, labeled, and logged by staff into proper disposal containers.

They need to contact staff regarding the disposal of waste.

Ask them to label and date any samples/chemical they leave at our facility for whatever reason and to inform staff about the same.

④ Emergency phone numbers

Dial 911 from any ANL landline for ALL emergencies, connects you to the Argonne dispatcher. Tell type of emergency, (chem. spill, heart attack, fire, riot) and dispatcher will send Hazmat, Paramedics, Fire or Police as appropriate. (Dial 630-252-1911 from a cell phone)

Response to alarms and other warnings

Show fire bells in LOM hallway

Show fire signs at 10ft level

Show fire pull-down alarm boxes (they are next to EVERY exit).

Show fire extinguisher by second F001 door and at the end of the hall between 438F and 438E.

Tell them to collect at the north side of Building 450 for head count in event of fire alarm.

Describe 'emergency tone' PA system alert for every other type of emergency.

Describe tornado warnings and watches.

Point out bathroom "tornado shelters" and explain shop as alternative.

In case of an emergency that requires an evacuation, proceed to the nearest exit and evacuate to the north side of Building 450 unless directed otherwise by a building Monitor wearing a yellow "Monitor" hat. Building Monitors will provide instructions to all personnel on where to proceed.

At this point, tell them about the kitchen facilities and mention "no alcohol."

⑤ *Now, take them into the ring. – Ensure they are wearing a dosimeter.*
Before entering the ring, direct them to always be watching for tricycle traffic, especially when entering from the main 438F entrance door.
Point out that Radiation Dosimeters are required to enter the APS Experiment Hall.
Show fire pull-down box by experimental hall exit doors (toward LOM).
Show location of fire extinguishers on bottom of every 5th column around ring.
On interior columns 169 and 167
Adjacent to 35-ID-E inboard and outboard sides
Show fire bells and exit signs at 15ft level.
Show shop "tornado shelter"
Show floor coordinator office and explain their responsibilities.

Next, show them the ring and sector layout and their station location. Explain naming system for APS experimental beamlines and hutches.

Various Operating Procedures (OPs) are stored in yellow placards outside the experimental stations or laboratories.

Point out laser operation indicator signs

Secure Locations
Only authorized personnel are allowed to enter the powder room (35-ID-PR)

Users are not allowed to enter the laser control area unless authorized. Authorized personnel must have LCA supervisor approval, have read and understand the Laser Safety Operating Procedures (SOP), and completed the APS Training Course: ESH120 and the associated eye exam. Appropriate safety eyewear must be worn at all times.

⑥ *Take them into <u>their</u> station:*

Location and requirements for the use of safety eyewear and other PPE
Show gloves, safety glasses.

Restrictions on working alone
Emphasize that they can NOT work alone if the work has a potential risk associated with it. An APS floor coordinator or the control room is on duty 24hrs (only one for the whole ring from midnight to 8am).

The importance of keeping work areas neat and orderly, and the aisles free of obstructions. *Keep it neat. Use common sense. Aisles must be free for fast fire egress.*

Storage of chemicals and gas cylinders

Any gas cylinders must be inspected and ALWAYS tied down. Chemicals when not in use must be stored in proper location. Cylinders must always be capped when being transported or stored, and person transporting cylinders must be wearing proper safety shoes and safety glasses.

Storage of other items (e.g., objects may not be stored on top of cabinets)

Common sense, good housekeeping again.
NO SHARPES in trash containers.
Any razorblades when not in use must be stored sharp end down in Styrofoam.

Restrictions on and proper use of electrical power strips and extension cords

No multiple ganged power cords, it is a fire and trip hazard. Power strips may not be permanently attached to anything (zip ties). They may only be temporarily attached (Velcro).

⑦ **Procedure for obtaining and using liquid nitrogen**

LN_2 may only be dispensed into a 4-liter transfer dewar. Pour liquid nitrogen into the low-form dewar flasks from the 4-liter transfer dewar.

The following PPE is required when handling LN2:

- *Cryogloves*
- *Face shields/Eyewear*
- *Apron*
- *Closed-toe, non-absorbent shoes*
- *Non-cuffed pants*
- *Cotton-fiber long-sleeve shirt*

⑧ **Cranes for hoisting and rigging**

Cranes are available for hoisting and rigging. Only authorized individuals may operate the cranes. Individuals must complete Training Course: APS21111 APS Incidental Chain Fall Hoist Operator Training and be authorized by DCS Manager. Authorized individuals must wear safety glasses, gloves, and steel toe shoes.

⑨ **Orientation to the DCS implementation of the APS Shielding Configuration Policy**

There are specialized Health Physics personnel that carefully check each station for radiation tightness on a regular basis. NO MODIFICATIONS of the station walls tagged station hardware, safety electronics, safety switches or safety cable ways are permitted. If modifications need to be made to the labyrinth, contact the floor coordinator and they can

remove the tag – this disables the beamline and you cannot open the shutter. Refer to DCS Training Brochure regarding shielding and configuration policy.

Locations of the utility shutoffs for electricity, water and compressed gases

All electrical cut-offs are located outside of the station.
All water cut-offs locations are listed below:
B and C Hutches: on inboard shield wall
D and E Hutches: on upstream wall
All compressed air cut-offs are located at the same locations as listed above.
Contact staff immediately in case of any emergency, water leak or gas flow problem.

- *Users can't do electrical work over 50 volts*
- *User electrical equipment must be inspected by the APS (equipment should be noted on the ESAF).*

General and beamline-specific operation of the Personnel Safety Systems

Demonstrate the entire search and secure process one step at a time.
Emphasize that only one person takes responsibility for a search.
EMPHASIZE the locations and use of the Emergency Stop buttons. ***It is absolutely forbidden to be in a station after it has been searched and secured.*** *Note that the manual door needs to be closed to engage the interlock system.*

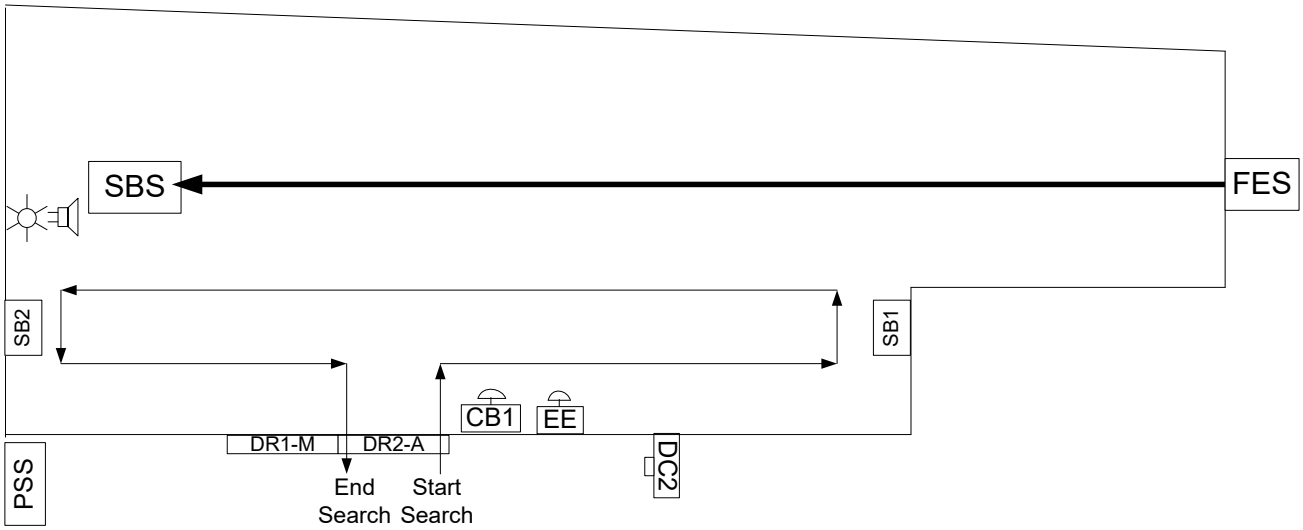
a) *Station safe > stop button disables station. Cannot take beam.*
b) *Station locked > locks all station doors. Must hit Emergency Door Release (yellow) button to open door.*
c) *Station with beam > kills ring in 600µsec.*

Search and Secure Procedure (for appropriate stations)

- *Look at buttons*
- *Yellow blinking button means it is ready*
  - *If button is not blinking, check doors and the Emergency Beam Stop button.*
  - *Explain search paths (attached)*
- *Leave area*
- *Hit 'Close Door' button*
  - *Watch to ensure no one enters the hutch*
- *When light turns green, it indicates it is ready, has been searched and secured, and the shutter can be opened.*
- *To open: hit red 'Open' button*
- *Emergency Beam Stop Button crashes the system and prohibits a search.*
  - *If it is inadvertently pushed in, pull it out.*

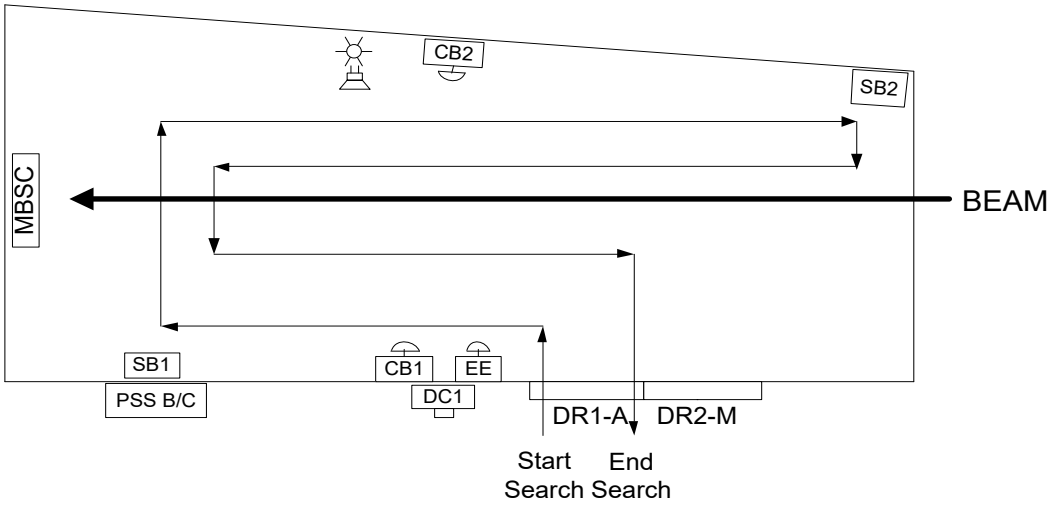
This is the end of the formal sector orientation. Have them complete and sign the Sector Orientation Checklist. Give all completed check lists to the Administrative Coordinator to file original and grant credit for APS Sector Orientation Course: APS235. Administrative Coordinator will make a copy for the user upon request.

Station A PSS Configuration



Initial Search Conditions: DR1 Closed, DR2 Open
Search Sequence: SB1-SB2-Close DR2
Search Time: 90 Seconds

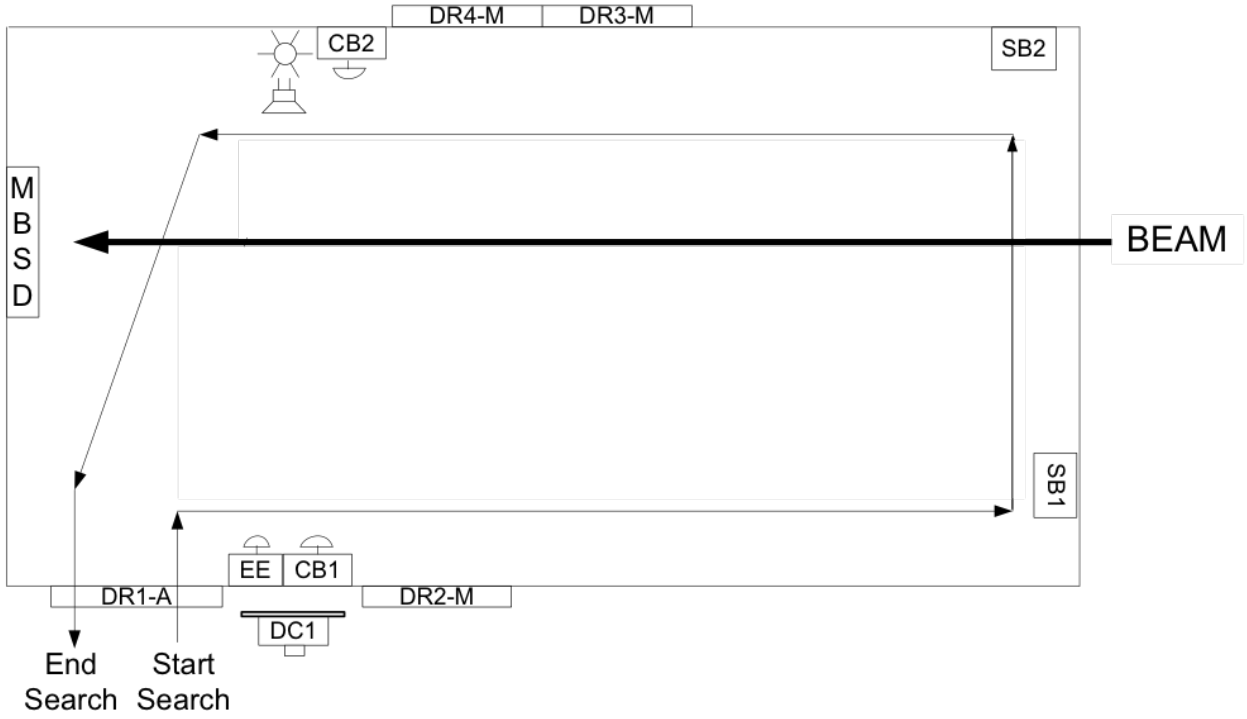
Station B PSS Configuration*



Initial Search Conditions: DR2 Closed, DR1 Open
Search Sequence: SB1-SB2-Close DR1
Search Time: 90 Seconds

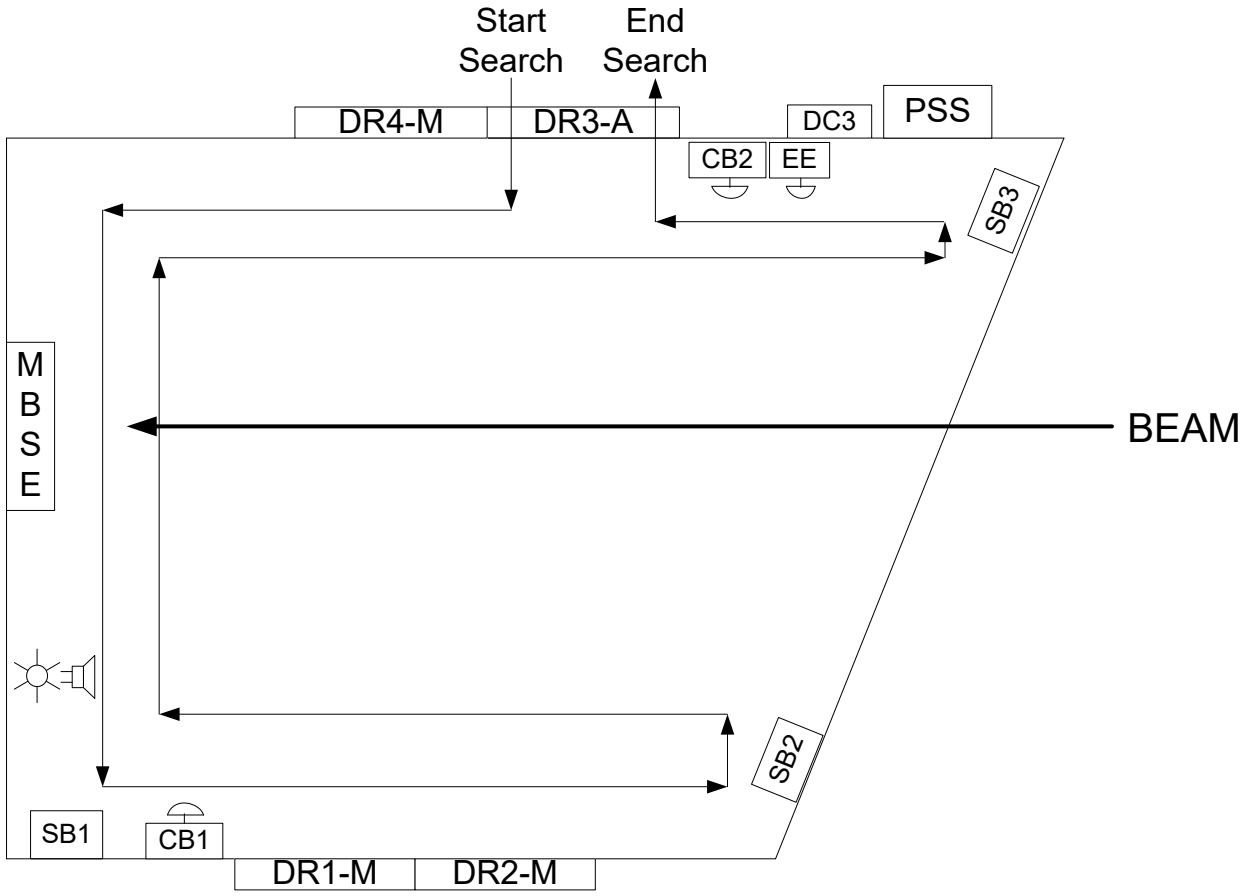
**May need to be modified depending on Experimental Configuration. DCS staff will determine appropriate search path.*

Station C PSS Configuration



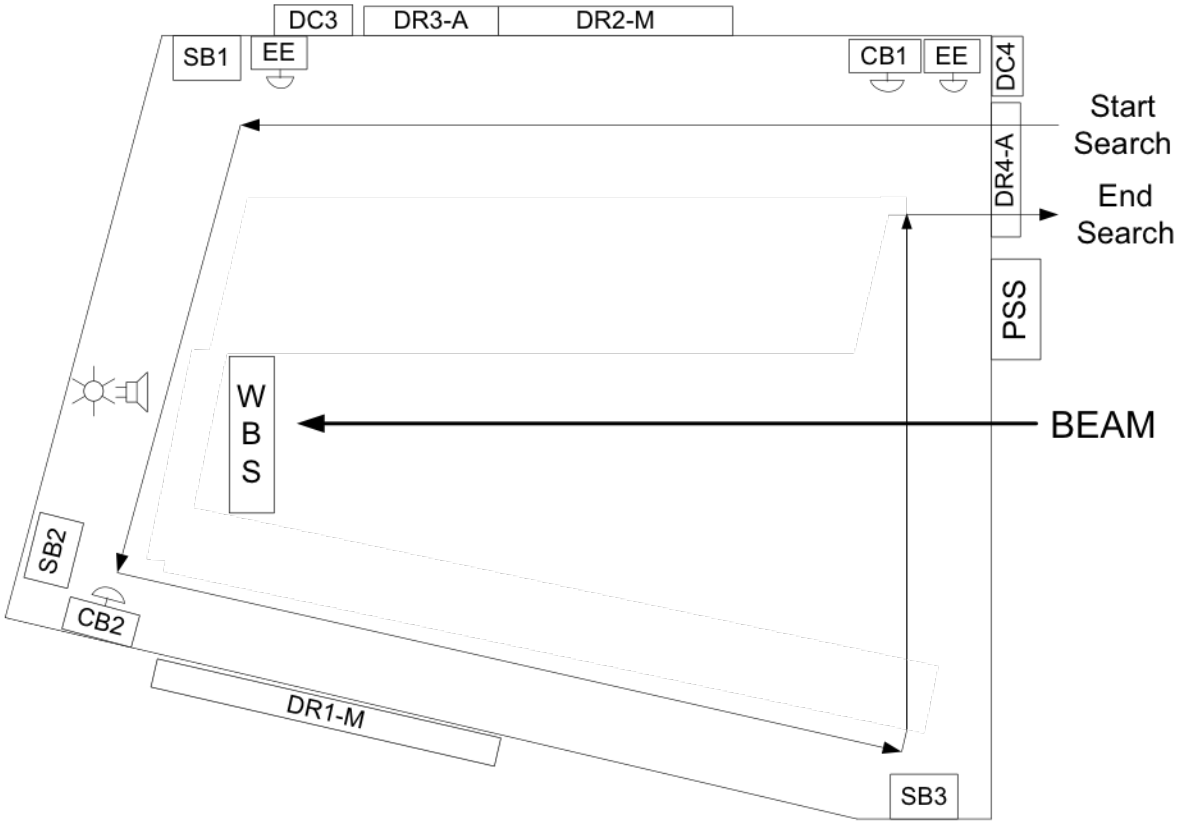
Initial Search Conditions: DR2, DR3 & DR4 Closed, DR1 Open
Search Sequence: SB1-SB2-Close DR1
Search Time: 90 Seconds

Station D PSS Configuration



Initial Search Conditions: DR1, DR2 & DR4 Closed, DR3 Open
Search Sequence: SB1-SB2-SB3-Close DR3
Search Time: 90 Seconds

Station E PSS Configuration



Initial Search Conditions: DR1, DR2, DR3, Closed, DR4 Open
Search Sequence: SB1-SB2-SB3-Close DR4
Search Time: 90 Seconds

Tri-fold User Safety Training Brochure

Safety at the APS

For all safety-related issues, please ask any DCS staff member how to proceed.

The DCS staff members and users of the DCS facilities are individually responsible for both their own safety and that of colleagues affected by their actions.

Safety Documentation

- All hazardous chemicals are logged using the CORAL SDS Database
- Online:
  https://www.aps.anl.gov/Safety/Resources
- Experiment Safety Forms: Located on Safety Information Board on control room doors

Site Alarms

Loud Steady Ringing of Fire Alarm Bells:
Immediately leave the building, wait outside.

Tornado or Severe Weather Siren:
Go to the tornado shelter immediately.
(Restrooms or Machine Shop if open)

Steady Tone & Special Notification:
Follow loudspeaker instructions.

Location of Safety Equipment

Fire Extinguishers:
Base of the interior columns 169 and 167. One outside of 35-ID-C, one inboard and outboard side of 35-ID-E. Two in LOM hallway in case of emergency only.

Shower/Eye Wash:
Chemistry Lab and Assembly Lab (eye wash only)

Safety Glasses/PPE:
Sample prep areas (Chemistry Lab and Station Control Rooms)

Chemistry Lab

- Users may use the chemical hood and benches in the Chemistry Lab. SDS sheets for all chemicals used must be available on CORAL.
- Be aware of Hazardous Waste Procedures.
- Wear safety glasses and follow clothing requirements at all times.
- Use gloves as appropriate.
- Place used sharps in sharps containers.

Beamline Safety

APS Shielding Configuration Policy

- Do not remove or modify any pink tagged lead for *any* reason.
- No station wall modifications permitted.

Electrical Safety

Sector 35 circuit breakers are located along the main aisle. Hutch and laser disconnects are located outside each hutch. Stop work, then operate in case of emergency only. ***Contact staff immediately.***

Liquid Nitrogen (LN2)

Use face shields/eyewear, cryogloves, apron, closed-toe non-absorbent shoes, non-cuffed pants, cotton-fiber long-sleeve shirt when handling LN2.

Personnel Safety System (PSS)

- Call a DCS staff member or the APS Floor Coordinator for any problem with the hutch interlock system.
- **ONLY ONE PERSON AT A TIME** may operate the PSS systems. The user taking responsibility for a search and secure of the station must follow all steps to completion.

Water Manifolds

Water flow problems will trip the Equipment Protection System (EPS).
Contact staff immediately.

General Housekeeping

- **Only drinks are allowed on the APS Experimental Floor. No food is allowed.**
- Keep the station and control room tidy and egress aisles clear.
- Use sharps container, gloves, and eye wear when required.
- ***Wear your ID badge at all times.***

Hazardous Materials

- Under no circumstances may you transport a nonexempt hazardous or flammable material to the APS in your own vehicle.
- For shipping explosive/flammable samples/materials to the DCS, contact the DCS Safety Coordinator (see DCS Safety Contacts list).
- For shipping other hazardous materials to the DCS, inform the DCS Transportation Safety Coordinator of shipment and address package to: https://dcs-aps.wsu.edu/shipping-instructions/

Liz Prokop, Transportation Safety Coordinator
DCS, APS Sector 35
c/o Building 46, HazMat Receiving
9700 South Cass Avenue
Argonne, IL 60439

- Please contact your local Safety Office for assistance with proper shipping methods for any hazardous samples/materials.
- Fill out User Shipping Request for shipping samples/materials from APS to home institution. Contact DCS Transportation Safety Coordinator.

DCS Safety Contacts

APS Floor Coordinator: 630-252-0101
Page – Enter Call-Back Number 2-0101

DCS Safety Coordinator:
Adam Schuman 630-252-6458
adam.schuman@wsu.edu

Impact Facility Supervisors:
Paulo Rigg 630-252-0462
Drew Rickerson 630-252-9815
Robert Zill 630-252-9870

Magazine Keepers:
Drew Rickerson 630-252-9815
Robert Zill 630-252-9870

Chemical Safety Coordinator:
Robert Zill 630-252-9870
robert.zill@wsu.edu

Laser Control Area Supervisor:
Paulo Rigg 630-252-0462
Xiaoming Wang 630-252-3807
Adam Schuman 630-252-6458

Electrical Safety Coordinator:
Xiaoming Wang 630-252-3807
xiaoming.wang@wsu.edu

Transportation Safety Coordinator:
Liz Prokop 630-252-9854
liz.prokop@wsu.edu

Hoisting and Rigging Coordinator:
Robert Zill 630-252-9870
robert.zill@wsu.edu

Machine Shop Coordinator:
Drew Rickerson 630-252-9815
drew.rickerson@wsu.edu

APS ESH Representative:
Paul Rossi 630-252-4192
prossi@aps.anl.gov

DCS Manager:
Paulo Rigg 630-252-0462
prigg@wsu.edu

Safety Phone Numbers

Emergency
- **CALL 911 IN ANY EMERGENCY**
- In-House 2-1911
- Cell/Outside 630-252-1911

Non-Emergency
- In-House 2-1811
- Cell 630-252-1811

Floor Coordinator 630-252-0101

Local Phone Numbers

DCS Admin	630-252-9854
Chemistry Laboratory	630-252-9878
Laser/Optics Laboratory	630-252-9876
Instrumentation Room	630-252-3578
Powder Room	630-252-3575
APS User Office	630-252-9090
APS User Office fax	630-252-9250

If using an In-House phone line:

- Outside Number: Dial '7' '1' + area code + 7-digit number
- In-House Number: Dial '2' + last 4-digits of number

ANL Guest House

- http://www.anlgh.org/
- E-mail: aghreservations@anl.gov
  Reservations: 1-800-632-8990 or
- 630-739-6000, fax: 630-739-1000
- On-site: dial 5, wait for tone, dial 0 or dial 5, wait for tone, dial 2 + 3-digit room number

APS Run Schedule:
https://www.aps.anl.gov/Machine-Status/APS-Long-Range-Operations-Schedule

User Safety Training

DCS Dynamic Compression Sector at the Advanced Photon Source
A DOE/NNSA Sponsored User Capability

dcs.admin@wsu.edu
(630) 252-9854

Sector 35
Advanced Photon Source
Argonne National Laboratory

For further information,
visit the DCS website: www.dcs-aps.wsu.edu

User Safety Training Checklist

1. **Affirmation and clarification of the safety first and Stop Work Responsibility** ☐
2. **Confirmation the DCS Conduct of Operations Manual has been read** ☐
3. **Explanation of the DCS general policies pertaining to control of hazards** ☐
4. **Introduction to the DCS Safety Coordinator and the DCS Manager and an affirmation of the importance of bringing all safety and environmental problems and concerns to their attention** ☐
5. **Location of safety equipment (fire extinguisher, shower, eyewash station, etc.)** ☐
6. **Safety documentation (CORAL SDS Database), safety, storage of chemicals and gas cylinders** ☐
7. **Disposal of waste, including hazardous waste** ☐
8. **Emergency phone numbers and ANL alarms** ☐
9. **Location and requirements for the use of safety eyewear and other PPE** ☐
10. **Orientation to the experimental station DCS implementation of the APS shielding configuration policy** ☐
11. **Location and explanation of PSS panel** ☐
12. **Experimental station search and secure procedure** ☐

User Name (Print): _____

Badge #_____ White Proxy # (11290435D…) _____

User Signature: _____ Date: _____

Training Provided By: _____

ATTACHMENT 11. PRE-JOB BRIEF

Impact Facilities Pre-Job Brief Checklist

Principal Investigator: Click or tap here to enter text.		**Organization:** Click or tap here to enter text.
DCS POC: Click or tap here to enter text.	**Recorder:** Click or tap here to enter text.	**Date:** Click or tap to enter a date.

Safety Checklist	
☐	Confirm ESAF was posted
☐	Confirm each onsite user is wearing a dosimeter. -Reminder: users must return device to the board at the end of each day.
☐	Confirm all materials have been represented on the ESAF and introduced to DCS
☐	Confirm all Users on the Zoom call are also on the ESAF (remote users on ESAF are not required to attend Pre-Job)
☐	In the event of an emergency, call 630-252-1911
☐	Roles and Responsibilities – Assign PIC, detector and interferometry operators for the campaign and discuss their responsibilities
☐	Discuss shot-procedure and checklist with Users
☐	Post-shot check with gun/laser operator and PIC that hutch is safe to enter
☐	Discuss any processes involving DCS-owned or user-owned pyrophoric materials
☐	Request User provides cell phone number for the white board
Operations Checklist	
☐	Provide staff schedule for duration of allocated time
☐	Discuss with User: X-ray beam energy, undulator, galvanometer shutter, and driver(s) utilized and any scheduled changes to these configurations as communicated to the DCS POC
☐	Discuss with User: Detector configuration (taper size or PCI magnification) and beamstop location as communicated to the DCS POC
☐	Q & A

SIGNATURE PAGE

NAME (PLEASE PRINT)	SIGNATURE	DATE

Laser Shock Facilities Pre-Job Brief Checklist

Principal Investigator: Click or tap here to enter text.		**Organization:** Click or tap here to enter text.
DCS POC: Click or tap here to enter text.	**Recorder:** Click or tap here to enter text.	**Date:** Click or tap to enter a date.

Safety Checklist	
☐	Confirm ESAF was posted
☐	Confirm each onsite user is wearing a dosimeter. -Reminder: users must return device to the board at the end of each day.
☐	Confirm all materials have been represented on the ESAF and introduced to DCS
☐	Confirm all Users on the Zoom call are also on the ESAF
☐	In the event of an emergency, call 630-252-1911
☐	Roles and Responsibilities – Assign PIC, detector and interferometry operators for the campaign and discuss their responsibilities
☐	Discuss shot-procedure and checklist with Users
☐	Post-shot check with gun/laser operator and PIC that hutch is safe to enter
☐	Discuss any processes involving DCS-owned or user-owned pyrophoric materials
☐	Request User provided cell phone number
Operations Checklist	
☐	Provide staff schedule for duration of allocated time
☐	Confirm with User: X-ray beam energy, undulator, and laser (attenuations, filters, pulse shapes) utilized and any scheduled changes to these configurations as communicated to the DCS POC
☐	Confirm with User: Detector to sample distance and x-ray incident angle as communicated to the DCS POC
☐	Confirm with User: Selection of targets mounted to first wheel and that a picture is available
☐	Confirm with User: VPF settings for Interferometry as communicated by the DCS POC

☐	Discuss any changes to sample wheels due to experiment changes, broken samples, etc.
☐	Q & A

SIGNATURE PAGE

NAME (PLEASE PRINT)	SIGNATURE	DATE

ATTACHMENT 12. POST-JOB BRIEF

Principal Investigator: Click or tap here to enter text.		**Organization:** Click or tap here to enter text.
DCS POC: Click or tap here to enter text.	**Recorder:** Click or tap here to enter text.	**Date:** Click or tap to enter a date.

1.) Any safety-related items that need to be addressed?

Click or tap here to enter text.

2.) Any broken equipment that you noticed?

Click or tap here to enter text.

3.) Any consumables/tools that were out of stock/unavailable?

Click or tap here to enter text.

4.) Suggested improvements or additional capabilities?

Click or tap here to enter text.

5.) Total number of shots (or relevant unit)? Identify unsuccessful shots (e.g., could have been prevented)?

Platform	Total Shots	Unsuccessful Shot #'s
Choose an item.		
Choose an item.		
Choose an item.		
Choose an item.		

6.) Received data? If not, what are you expecting from DCS?

A. Received all experimental data? ☐YES ☐NO, DCS needs to provide: Click or tap here to enter text.

B. Spectral scan provided in your Globus database? ☐YES ☐ NO, DCS needs to provide: Click or tap here to enter text. ☐NA – Didn't need one

C. User Team, acknowledges receipt of all experimental data produced during this experimental series and understands how to access data within the Globus database? ☐YES ☐NO

Name (PI or Delegate):Click or tap here to enter text. Date:Click or tap to enter a date.

7.) Were any of the following items borrowed from DCS? Return to the DCS PIC at this time.

☐ White Prox Card (Door Access) ☐DCS Visitor's Badge ☐Ethernet Cables ☐Other Click or tap here to enter text. ☐NA

DCS Recorder: I confirm all borrowed items were returned ☐YES ☐NO

8.) Return Shipments: User has completed return shipment packaging, placed container(s) in F030, and emailed DCS Admin detailed instructions on return ship needs (contact name/phone, FedEx acct #, due date).

☐YES ☐No items to ship ☐NO Comment: Click or tap here to enter text.

9.) User has cleaned up the User Workstation Area (garbage thrown away, desk wiped down)

☐YES ☐NO Comment: Click or tap here to enter text.

Note that the Laser Station Post-Job also includes a question asking, "Received VISAR calibration data/center slit of alignment from which x-rays are probing?
☐YES ☐ NO, DCS needs to provide: ☐NA – Did not need one
And, adds Target Wheel as a borrowed option.

ATTACHMENT 13. FEEDBACK FORM (EVALUATION OF DCS USERS)

1. **Did you interact with this user group before, during or after their experimental time? (If you state no, simply return your feedback without answering further questions)**

2. **All user information was provided to the DCS (If no, provide detail)?**
    a. Before user arrived?
    b. With sufficient time to make all DCS preparations?
    c. Samples were prepared and ready to attach to DCS supplied target plates?
    d. Configuration for Special Purpose experiments was anticipated?
    e. Online Training was completed prior to arrival?
    f. Globus loaded to their laptop to retrieve data?

3. **Describe any untimely occurrences or general comments on experimental preparedness in pre-arrival that may be helpful for future improvements.**

4. **Did users participate in experiments?**
    a. Final Setup of Target
    b. Completion of Timing Worksheet
    c. Other

5. **Describe other ways that users participated and/or could have been more helpful.**

6. **Describe all issues that occurred during this experimental time.**

7. **Describe all improvements/changes that should be made before or during the next visit.**

8. **Describe what went well and could serve as a model for future best practices or should be communicated to the user to encourage the same in the future.**

ATTACHMENT 14. USER FEEDBACK FORM (EVALUATION OF DCS)

DCS User Feedback, Run XXXX-X
${e://Field/RecipientLastName} ${e://Field/Organization}
${e://Field/Dates}, ${e://Field/Station}, ${e://Field/Technique}

Please provide your name:

- ○ First Name _____
- ○ Last Name _____

Prior to your arrival, how would you rate the assistance you received from the DCS Staff regarding design and preparation of your experiments? (1 Star = Poor, 5 Star = Excellent)

☆ ☆ ☆ ☆ ☆

Were all requested preparations ready when you arrived?

- ○ Yes
- ○ No _____
- ○ Not Applicable

While at the DCS, how would you rate the experimental support you received from the DCS Staff? (1 Star = Poor, 5 Star = Excellent)

☆ ☆ ☆ ☆ ☆

While at the DCS, what additional support would have been beneficial?

_____

Please comment on the performance of capabilities utilized while at the DCS such as drivers (gas gun, laser) X-ray measurements, Optical measurements, etc.

_____

While at the DCS, did you receive all experimental data and any additional information you require to access the Globus database?

- ○ Yes
- ○ No _____

How many shots were completed during your experimental series?

_____

What went well and what would you like to see again on your next visit to the DCS?

_____

Do you plan to publish the results of your experiments conducted at the DCS?

○ Yes

○ No

Display This Question:

If Do you plan to publish the results of your experiments conducted at the DCS? = Yes

When do you anticipate an accepted manuscript and/or publication date?

_____

Display This Question:

If Do you plan to publish the results of your experiments conducted at the DCS? = No

It is the expectation that users will publish their DCS experimental work in journals, books, conference proceedings, or other printed scientific and technical media. Please provide detail as to why publications will not be pursued.

_____

The Acknowledgment Statement at dcs-aps.wsu.edu/publication-acknowledgements must be included in manuscripts for experimental work conducted at the Dynamic Compression Sector and published in journals, books, conference proceedings, or other printed scientific and technical media.

Please notify the DCS of publications based on experimental work at the DCS and send the copyright-free version of accepted manuscripts to dcs.admin@wsu.edu. In addition, please enter your accepted manuscript into the APS Publications Database (www.aps.anl.gov/Science/Publications.)

I understand Publication Acknowledgement for work conducted at the Dynamic Compression Sector.

○ Yes

Please provide any additional comments or suggestions for improvement:

_____