Sanford Underground Research Facility

ENVIRONMENT, SAFETY AND HEALTH

BLASTING POLICY

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1.0 POLICY

Any blasting, either on the surface or underground, will be a permit-required activity at the Sanford Underground Research Facility (Sanford Lab). The blasting permit process will assure that thorough investigation and planning are performed and the hazards associated with the use of explosives are identified and mitigated. For the purpose of this document, blasting is defined as the use of explosives that may:

- Injure persons or damage property
- Disrupt or damage science experiments, schedules or assets, including but not limited to cryogenic fluids or gases such as liquid nitrogen, xenon, or argon.

2.0 SCOPE

This policy applies to Sanford Lab personnel and to all contractors and sub-contractors that may handle, store, utilize or transport explosives involving any blasting procedures.

3.0 BLASTING PERMIT

Sanford Lab requires approval of all Blasting Permits by a Permit Authorizing Individual (PAI) of a Blasting Permit in advance of any blasting operations. Blasting Permits are risk based and will be rated on the risks associated with each permit request, the work scope and the potential impact to occupied spaces, cryogens, science experiments, and other high value assets.

Blasting Permits are not required for:

1. The use of powder actuated tools (covered by OSHA 1910.243(d) and 1926.302(e))
2. The use of the EzeBreak Micro-Blaster.

Blast Permit Risk Criteria;

High Risk - Blasting within 500 feet (defined by a straight line in any direction) of occupied space, shafts, cryogens, liquid or gas storage, science experiment equipment, or other high value assets

Low Risk - Blasting not meeting any of the criteria listed above.

The Permit Authorizing Individual (PAI) for high-risk blasting will be the Sanford Lab Laboratory Director. The PAI for low-risk blasting will be the Environment, Safety and Health (ESH) Director.

A Blasting Permit for operations defined as high risk will require the prior approval of a Blast Plan. A Blasting Permit for operations defined as low risk may require the prior approval of a Blast Plan at the discretion of the ESH Director or the Laboratory Director.

4.0 BLAST PLAN

A Blast Plan will be required for "high risk" Blasting Permits and may be required for "low risk" Blasting Permits. The Blast Plan will include an analysis of the hazards and controls to be implemented.

The Blast Plan will be risk based with decisions governed by sound engineering principles. The goal of the Blast Plan will be to outline, with a high degree of confidence, the precise outcome of each blast. It will assess every aspect of the blast environment from the type and condition of the rock, the proximity and disruptive limit of assets, life safety of the blast crew and other Sanford Lab occupants, design and type of explosive, and the integration of the blast with subsequent activities such as rock removal, ground support and additional blasting. Sample contents of a Blast Plan are outlined in section #6.

The Blast Plan will use appropriate risk assessment tools in conjunction with the Sanford Lab Risk Management Plan to identify, quantify, mitigate, and respond to risks associated with blasting. This will include Risk Identification, both qualitative and quantitative, as well as assessment of risk both pre- and post-mitigation. Post-blast analysis will be performed on every shot to determine how accurate the effects of the blast were predicted. This information will be archived as well as incorporated into subsequent shots to improve the system utility.

Every Blast Plan will be reviewed by the ESH Director and the Science Director. Once the content of the Blast Plan is reviewed and found suitable, it will be approved by the Laboratory Director.

5.0 WORKFLOW AND RESPONSIBILITIES

Steps required to obtain a Blasting Permit:

1. Notify the Sanford Lab ESH Director that explosives are proposed for use at the facility for a project or science experiment
2. Provide the ESH Director with a project-related work plan that describes the proposed location, purpose, type, amount, and timing of explosives use. The work plan may be informal and is only expected to provide sufficient understanding of the proposed work to allow the next step to commence. The work plan is not expected to contain all the elements of a Blast Plan.
3. The ESH Director will determine if the proposed use of explosives requires a Blasting Permit in accordance with this policy
4. If the proposed use of explosives meets the definition of blasting and requires a Blasting Permit, the ESH Director will determine if the blasting operation is categorized as high risk or low risk, and if a Blast Plan will be required
5. If a Blast Plan is required, submit the Blast Plan to the ESH Director for review at least two weeks before the proposed use of explosives
6. If a Blast Plan is required, the ESH Director and Science Director will review the document and recommend approval or disapproval to the Laboratory Director.

7. If a Blast Plan is required, the Laboratory Director will approve the Blast Plan at least one week prior to the proposed use of explosives
8. Obtain a properly signed Blasting Permit from the ESH Department at least two days prior to the proposed use of explosives
9. Perform the blasting operations in accordance with the Blasting Permit and Blast Plan (if required)
10. Perform post-blast analyses and submit required documentation to the ESH Director in accordance with the Blasting Permit.

The ESH and Laboratory Directors may engage internal or external personnel to review the Blast Plan and provide comment prior to approving the document.

Contractors performing blasting activities must follow these same steps and approvals. The contractor is required to produce all documents, though the Sanford Lab Project Manager or Owner's Representative may assist. All documents must be reviewed and approved by the Sanford Lab Project Manager or Owner's Representative prior to submittal to the ESH Director.

6.0 BLAST PLAN SAMPLE CONTENTS

All Blast plans will have, at a minimum, the following sections. The details described within each section herein are provided as general guidelines of the type of information that should be included. This should be adjusted to suit the specific blasting activity.

1. SCOPE OF WORK

The Blast Plan Scope of Work will document details relating to the blast that may include but are not limited to drill hole dimensions and patterns, types and quantities of explosives utilized, shot firing sequence and timing, and distance of the blast to infrastructure.

Blast Plans will reference procedures such as Standard Operating Procedures (SOPs) or Job Hazard Analyses (JHAs) detailing pre-blast preparations for clearing and guarding the blast zone.

2. DOCUMENT CONTROL

Distribution Register (Who was included in creating and reviewing the Blast Plan)
Revision List (What changes were made and when)

3. SPECIFIC BLAST PLAN ITEMS

- Appointed Persons
- Consultation (experts consulted to develop the plan)
- Personal Protective Equipment (PPE) required
- Hazardous Substances used or in proximity to the blast
- Lifting Gear used
- Warning Signs and Control Measures (Section 5 should provide detail)

- Accidents and Incident Response plans
- Fire Protection Controls
- Permits and Licenses Required (beyond the Blast Plan and Blasting Permit)

4. RISK ASSESSMENT

A Blast Plan considers the hazards presented by blasting activities that may negatively affect Sanford Lab operations. The hazards considered include but are not limited to:

- The effects of the blast energy transmitted through the rock (shock wave) to include the frequency and amplitude of blast vibrations
- The effects of the blast energy transmitted through the air (air blast)
- Potential flyrock
- The gases and dust produced by a blast
- The effects of noise on personnel
- Effects to normal traffic patterns prior to, during, and after blasting activities

The Blast Plan will use a risk assessment process to identify, quantify, mitigate and respond to risks associated with blasting. The risk assessment process is to include Risk Identification, Risk Analysis, Risk Mitigation, Post-blast Mitigation Assessment. Additionally, post-blast analyses will be performed following each blast to determine the accuracy of the pre-blast predictions and applicability of pre-blast mitigations; the results will be archived by both the ESH department and will be referenced to improve subsequent blast design.

The Blast Plan will have provisions for blasting commensurate with the potential for harm. Blasting proximal to occupied spaces, shafts, cryogens, liquid or gas storage, science experiment equipment, or other high value assets will receive special attention to prevent injury to personnel or damage to structures or equipment.

Other elements that may be included:

- Summary of risk brainstorming points
- Summary of risk matrix and conclusions
- Other procedures and documents discussed
- Context of risk assessment
- Risk evaluation table: Potential consequences, likelihoods, risk level, etc.
- JHA
- Consequential Issues
- Miscellaneous Issues
- Post Blast Activities

5. BLAST DEMARCATION AND PROTECTION

This section describes the limits of access control, what types of barricades will be used, where and when they will be placed, and what personnel are allowed during each stage of the process. Graphics are encouraged.

6. BLAST FIRING PROCEDURE

Key Hazards

Process Steps:

- Communication of Blasting Schedule on the Blast Day
- Pre-blast planning
- Early Equipment Movement
- Pre-blast meeting
- Blast Zone Evacuation
- Securing of Blast Exclusion Zone
- Clearing Runs
- Final checks and firing of blast
- Post blast inspection and All Clear
- Shot firer
- Blast Guard List
- Clearance Check
- Radio Call
- Final Clearance Check
- Radio Call
- Post Blast Inspection
- Steps to restore access
- Communication that access has been restored

9. BLAST PLAN REVIEW AND APPROVAL

This section shall include a place for the Sanford Lab ESH and/or Laboratory Director to sign and date approval of the plan, as well as a section for all individuals involved in the physical implementation of the plan to acknowledge that they have reviewed the plan prior to start of work.

7.0 REFERENCE AND RELATED DOCUMENTS

Explosives Regulations – All governmental regulations concerning explosives are to be followed, including but may not be limited to:

OSHA 1910.109 - Explosives and blasting agents.

OSHA 1926 Subpart U - Blasting and the Use of Explosives

- ***1926.800(k)(5)***
- ***1926.800(p)***
- ***1926.800(p)(1)***
- ***1926.800(p)(2)***

MSHA Title 30 → Chapter I → Subchapter K → Part 57 >> Subpart E—EXPLOSIVES

South Dakota state explosives permit rules

Sanford Lab ESH Explosives Safety Document EHS-7005-L1-01

Sanford Lab Blasting Permit Form

Sanford Lab Blasting SOP