
SUBJECT AREA CONTENT

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Management System: [Worker Safety and Health](#)

Subject Area: Concrete and Masonry Penetrations



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Effective Date: Oct 30, 2014 (Rev 1.0) Periodic Review Due: Oct 30, 2019	Subject Matter Expert: Tom Conrad John Ellerkamp Jr	Management System Executive: Ed Nowak	Management System Steward: Gail Mattson
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Introduction

This subject area describes the process for both aggressive and non-aggressive concrete and masonry penetrations.

All personnel involved in the planning, supervision and execution of penetrations at BNL (i.e., employees, and contractors) must follow these procedures which include the penetration permit for buildings and structures that are known or suspected to contain utilities.

Construction and non-construction cContractors are also required to follow these procedures in accordance with their approved Safe Work Plan or Phase Hazard Analysis and their BNL-accepted Health & Safety Plan.

Aggressive concrete and masonry penetration methods may include drilling, saw cutting, jackhammering, powder/gas-actuated piercing (using a Hilti for example), core-drilling, or other methods.

Applicability/Purpose

All BNL staff, and contractors use the controls established in this process to avoid the possibility of contacting utilities buried in the concrete and/or masonry (i.e., conduit, water lines, etc.).

This process establishes the requirements for safe concrete and masonry penetrations that will

- Prevent death or injury, property damage, or environmental insult associated with striking or breaking existing concealed utilities;
- Prevent unexpected project delays due to utility damage; and
- Prevent the disruption of utilities that will adversely affect facility safety services (for example: a strike damaging fire protection communication services).

Aggressive concrete and masonry penetrations will be avoided when near energized utilities (for example: electrical, water, steam, natural gas). When these, and other utilities, might be present, relocate the penetration, where possible, or make every effort to de-energize and lock

out utilities, which could be encountered or struck. If necessary, planned outages of local circuits or buildings are the preferred method.

For assistance, contact the Concrete and Masonry Penetration Subject Matter Experts (x7493 and x5789).

Contents

Section	Overview of Content (see section for full process)
<u>1. Determining and Planning Whether the Penetration is Aggressive or Non-Aggressive</u>	<ul style="list-style-type: none">• Ensure locations of proposed aggressive concrete and masonry penetrations are clearly marked.• Ensure all required actions are completed, including Section C of the Concrete and Masonry Aggressive Penetration Permit.• Ensure an appropriate Energized Electrical Work Permit is in place, when required.• Ensure any changes that deviate from original scope of planned penetration are captured in the Concrete and Masonry Aggressive Penetration Permit.• Re-evaluate penetration process when there is a ground fault interruption of the penetrating tool.• Determine if penetration is aggressive or non-aggressive.
<u>2. Identifying Potential Utilities in the Penetration Area</u>	<ul style="list-style-type: none">• Visit work site of the proposed penetration with Project Lead to evaluate location.• Indicate if GPR scanning is required in Section B of the Concrete and Masonry Aggressive Penetration Permit.• Use the GPR in accordance with the Concrete and Masonry Aggressive Penetration Permit.
<u>3. Authorized Workers Performing Aggressive Penetrations</u>	<ul style="list-style-type: none">• Worker reviews the Concrete and Masonry Aggressive Penetration Permit, the marked up utility drawings, and Energized Electrical Work Permit (when required).• Ensure GFCIs are utilized when AC electrical equipment is used for the penetrating operations.• Sign Section E of the Concrete and Masonry Aggressive Penetration Permit, before proceeding with work.

4. Workers Performing Non-Aggressive Penetrations

- Workers must use/wear required PPE.
- Investigate the presence of embedded utilities in the proposed work site.
- If there are no embedded utilities at the penetration, then non-aggressive penetration is permissible by hand chiseling only.
- Use non-aggressive penetration for hollow block walls.

5. Urgent/Emergency Penetrations

- Review the site, available drawings and other available information.
- Prior to the start of the urgent penetration, obtain the required concurrence.

Definitions

Exhibits

What Makes the Penetration Aggressive or Non-Aggressive?

Forms

Aggressive Concrete and Masonry Penetration Evaluation Procedure/Checklist

Concrete and Masonry Aggressive Penetration Permit

Training Requirements and Reporting Obligations

This subject area contains the following training requirements:

Electrical Safety I (TQ-ELECSAF1), Electrical Safety for Benchtop Workers (TQ-ELECT-BENCHTOP), Electrical Safety for Shock Hazard (TQ-ESHOCK)

CPR Training (TQ-ADULTCPR) (not for healthcare professionals) is available through the BNL Training and Qualifications Office.

Lockout/Tagout (LOTO) (HP-OSH-151B-W), Lockout/Tagout - Affected Employee (HP-OSH-151A-W)

External/Internal Requirements

No external requirements are associated with this Subject Area

References

Electrical Safety Subject Area

Personal Protective Equipment and Respirators Subject Area

Standards of Performance

All staff and guests shall share information based on experience (e.g., lessons learned) to promote continuous improvement in business and work practices.

All staff and guests shall carry out appropriate emergency responses and off-normal event follow-up activities.

All staff and guests shall promptly report accidents, injuries, ES&H deficiencies, emergencies, and off-normal events in accordance with procedures.

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PROCEDURE: DETERMINING AND PLANNING WHETHER THE PENETRATION IS AGGRESSIVE OR NON-AGGRESSIVE

Management System: Worker Safety and Health		
Subject Area: Concrete and Masonry Penetrations		
1. Determining and Planning Whether the Penetration is Aggressive or Non-Aggressive		
Effective Date: Oct 30, 2014	Subject Matter Expert: Tom Conrad John Ellerkamp Jr	Management System Executive: Ed Nowak

Applicability

This information applies to BNL staff and non-BNL staff who plan, supervise, or implement concrete and/or masonry penetrations.

Required Procedure

The Project Lead determines whether the needed penetration is aggressive or non-aggressive. The Project Lead assembles an appropriate team (to include the Facility Project Manager, Complex Engineer, or Research Space Manager Contractor/Worker responsible for the execution of the work and/or others deemed necessary by site conditions).

Step 1	The Project Lead reviews available "as-built" drawings and utility maps to identify the presence of known utilities (for example: electrical lines, communication lines, and other utilities) in the penetration area, followed by a walk-down of the work site for visible evidence of the existence of utilities or piping/conduit penetrations (complete the Concrete and Masonry Aggressive Penetration Permit). Caution: Not all BNL "as-built" drawings have accurate information, especially in older buildings.
Step 2	The Project Lead contacts the Facility Project Manager at the affected facility to ascertain if there is any knowledge of utilities located within the penetration area, and if other utility identification information is available (for example: pictures, utility surveys, etc.). Note: Relevant drawings are collected and attached to the permit for distribution to the utility representatives.

<p>Step 3</p>	<p>The Project Lead ensures that the locations of all proposed aggressive concrete and masonry penetrations are clearly marked in the field work site to indicate the area that will be penetrated, as well as areas that are not to be penetrated (e.g., areas within five [5] inches of fixed obstructions, such as walls, pipes and columns).</p> <p>The Project Lead reviews the Concrete and Masonry Aggressive Penetration Permit to ensure that it is completed and includes the request that all utilities in the penetration area be identified and marked (see the section Identifying Potential Utilities in the Penetration Area).</p> <p>The Project Lead ensures the following occurs:</p> <ul style="list-style-type: none"> • Each Utility Representative signs off Section B of the Concrete and Masonry Aggressive Penetration Permit; • Discussion of LOTO for all known utilities in the area has taken place. <p>In addition to the Concrete and Masonry Aggressive Penetration Permit, the Project Lead must complete and record the Aggressive Concrete and Masonry Penetration Evaluation Procedure/Checklist.</p>
<p>Step 4</p>	<p>The Project Lead ensures that all required actions are completed, including Section C of the Concrete and Masonry Aggressive Penetration Permit, which includes the Ground Penetrating Radar (GPR) scanning report to determine if utilities have been identified within 18 inches minimum of the penetration edge.</p> <p>If utilities are suspected, but cannot be identified through GPR within 18 inches minimum of the penetration edge, every effort must be made to</p> <ol style="list-style-type: none"> 1. relocate the penetration; 2. de-energize the utility prior to the penetration; or 3. perform the penetration by careful hand chiseling. <p>If items 1, 2, and 3 are not possible, then the penetration must be performed with an electrical energized work permit.</p>
<p>Step 5</p>	<p>The Project Lead ensures that an appropriate Energized Electrical Work Permit is in place, when required per the Electrical Safety Subject Area, and verifies that workers performing the work are Authorized Workers.</p>
<p>Step 6</p>	<p>The Project Lead ensures that any changes that deviate from the original scope of the planned penetration and affect the requirements of the procedure result in an updated Concrete and Masonry Aggressive Penetration Permit.</p> <p>The Project Lead completes Section D of the Concrete and Masonry Aggressive Penetration Permit to authorize the penetration to be performed. A copy of the Permit is attached to the work package distributed to the field, and the original with attachments is retained per procedures. The Personnel Acknowledgements (page 1 of the work package packet) is collected at the conclusion of the penetration.</p>
<p>Step 7</p>	<p>The Project Lead will re-evaluate the penetration process when there is a ground fault interruption of the penetrating tool, which may indicate that either a defective</p>

	<p>tool was used during the penetration process, or an energized utility was contacted. The Project Lead may wish to involve other members of the team in the re-evaluation.</p> <p>Note: The re-evaluation must include</p> <ul style="list-style-type: none">• Inspection of the power tool;• Inspection of the GFCI; and• Other methods/actions deemed appropriate by the Project Lead and the team.
Step 8	The Project Lead determines if the penetration is aggressive or non-aggressive using the exhibit What Makes it Aggressive or Non-aggressive? .

References

[Electrical Safety](#) Subject Area

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PROCEDURE: IDENTIFYING POTENTIAL UTILITIES IN THE PENETRATION AREA

Management System: Worker Safety and Health		
Subject Area: Concrete and Masonry Penetrations		
2. Identifying Potential Utilities in the Penetration Area		
Effective Date: Oct 30, 2014	Subject Matter Expert: Tom Conrad John Ellerkamp Jr	Management System Executive: Ed Nowak

Applicability

This information applies to all employees, contractors, guests, and students at BNL, who may be called upon to identify potential utilities.

Required Procedure

Utility Representatives identify all known utilities and their sources in the penetration area and complete Section B of the [Concrete and Masonry Aggressive Penetration Permit](#) for their utilities as follows:

Step 1	Utility Representatives visit the work site of the proposed penetration with the Project Lead to evaluate the location. Note: A site visit is required unless it is known that the utility type is not in the specific area.
Step 2	Utility Representatives indicate if GPR scanning is required in Section B of the Concrete and Masonry Aggressive Penetration Permit. If scanning is required, the complete set of drawings that is attached to the Permit must be distributed to the GPR scanning operator. The Utility Representative must ensure that the utilities are marked as accurately as possible and signs the Permit. Note: The signature is the Utility Representative's statement that their utility is not at risk if the penetration is done at the specified location and done in the manner described, with any qualifications as the Utility Representative noted on the Permit.

Step 3

Where required by the Project Lead/Permit, personnel using the GPR must do the following:

- Investigate the exact site area that is intended for penetration and the area surrounding the penetration by a distance of 18 inches from the penetration edge, and indicate the distance beyond the penetration by marking on the concrete.
- If an unknown item is found, GPR personnel must report the issue.
- If a known or suspected utility cannot be reliably located to satisfy these requirements, the Project Lead continues by having the utility de-energized, shut down, locked-out/tagged-out (LOTO'd), and proceeds with the penetration, making note of this qualification and condition in Section D of the Concrete and Masonry Aggressive Penetration Permit.

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PROCEDURE: AUTHORIZED WORKERS PERFORMING AGGRESSIVE PENETRATIONS

Management System: Worker Safety and Health		
Subject Area: Concrete and Masonry Penetrations		
3. Authorized Workers Performing Aggressive Penetrations		
Effective Date: Oct 30, 2014	Subject Matter Expert: Tom Conrad John Ellerkamp Jr	Management System Executive: Ed Nowak

Applicability

This information applies to all employees, and contractors performing aggressive penetrations at BNL.

Required Procedure

Workers must not work alone and must be in the line of sight at all times with at least one other similarly trained worker (follow the [Electrical Safety](#) Subject Area). The workers have been briefed on the scope of work to be performed.

Step 1	The worker reviews the Concrete and Masonry Aggressive Penetration Permit, marked up utility drawings, and Energized Electrical Work Permit (when required), if known or suspected utilities are not locked out/tagged out (LOTO'd) and in the vicinity of the penetration location.
Step 2	Workers ensure that Ground Fault Circuit Interrupters (GFCIs) are utilized when AC electrical equipment is used for the penetrating operations. When a ground fault is activated during the penetration process, workers must stop the job and notify the Project Lead.
Step 3	Workers ensure that they work responsibly, maintain the utility markings, and inspect the area as work progresses.
Step 4	Before proceeding with work, sign Section E of the Concrete and Masonry Aggressive Penetration Permit. Each start (for example: each new day or shift) requires a new review and signature.
Step 5	Workers must use/wear the following required personal protective equipment

(PPE):

- Wear Class 0 (1 kV rated) insulating gloves under leather gloves. The insulating gloves must be inspected and maintained in conformance with the manufacturer's requirements;
- Wear non-conductive safety glasses;
- Wear other PPE as required by the work permit;
- Use a Type I Class 2 electrical safety mat in wet conditions, or a Type I or II, Class 2 in dry conditions, or wear electrical safety footwear rated for 1,000 volts;

Note: These must be inspected and maintained in conformance with the manufacturer's requirements.

Note: Work performed while on a non-conductive ladder or any type of non-conductive aerial lift does not require a safety mat nor footwear as long as the conditions are dry and non-conductive.

References

[Electrical Safety](#) Subject Area

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PROCEDURE: WORKERS PERFORMING NON-AGGRESSIVE PENETRATIONS

Management System: Worker Safety and Health		
Subject Area: Concrete and Masonry Penetrations		
4. Workers Performing Non-Aggressive Penetrations		
Effective Date: Oct 30, 2014	Subject Matter Expert: Tom Conrad John Ellerkamp Jr	Management System Executive: Ed Nowak

Applicability

This information applies to all employees and contractors at BNL assigned to perform non-aggressive penetrations.

Required Procedure

The worker(s) performing the non-aggressive penetration must follow the steps below:

Step 1	Investigate the presence of embedded utilities in the proposed work site by <ul style="list-style-type: none">• Performing a visual inspection of all accessible sides (for example: both sides of a wall, above the ceiling, etc.) of the work area to determine the existence of any utilities or piping/conduit penetration.• Using appropriate toning/locating equipment capable of detecting metal and interior wiring in concrete or masonry up to a depth of three inches.
Step 2	If toning/locating equipment cannot clearly establish that there are no embedded utilities at the penetration, then non-aggressive penetration is permissible by hand chiseling only.
Step 3	If a utility is detected within the scanned area of the penetration, the penetration must be relocated, if possible, to avoid the utility. Otherwise lockout/tagout (LOTO) of the utility must be performed.
Step 4	If penetration must be made through hollow block walls, it can generally be completed within the bounds of non-aggressive penetration as follows: <ul style="list-style-type: none">• Scan for utilities; and• Use non-aggressive means to expose the cavity to allow for positive visual

confirmation that no utilities are present within the cavity that would present a hazard to the persons performing the penetration.

An example of a non-aggressive penetration into or through a hollow block wall is described below:

- The block is scanned for utilities;
- The hollow is exposed for visual inspection using tools permitted by non-aggressive methods (for example: A drill equipped with a drill bit of less than one inch in diameter and a drill stop set to less than 3 inches. It is strongly recommended that a drill interrupter be used if a handheld powered impact drill/hammer is used.);
- The cavity is inspected visually for utilities, and no utilities are identified; and
- The remainder of the block covering the hollow is removed using a handheld powered impact chisel or similar device.

The process can be repeated to penetrate the backside of the hollow block.

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PROCEDURE: URGENT/EMERGENCY PENETRATIONS

Management System: Worker Safety and Health		
Subject Area: Concrete and Masonry Penetrations		
5. Urgent/Emergency Penetrations		
Effective Date: Oct 30, 2014	Subject Matter Expert: Tom Conrad John Ellerkamp Jr	Management System Executive: Ed Nowak

Applicability

This information applies to all employees and contractors performing work at BNL.

Required Procedure

In cases where it is easily recognizable that an urgent aggressive penetration is needed and it is not practical to secure a Concrete and Masonry Aggressive Penetration Permit, follow the steps below:

Step 1	The responsible manager/supervisor/Project Lead must review the site, drawings, and other available information.
Step 2	Workers must be Authorized Workers wearing the required PPE for aggressive penetrations.
Step 3	After reviewing the work site, the responsible manager/supervisor/Project Lead determines that the work would not degrade the property, nor the environment.
Step 4	Prior to the start of the urgent penetration, obtain concurrence from the Department Chair/Division Manager or designee and the Safety and Health Services Division (SHSD) Manager or designee.

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DEFINITIONS

Definition: Concrete and Masonry Penetrations

Term	Definition
aggressive concrete and masonry penetrations	Except where permitted as a non-aggressive penetration, any concrete or masonry penetration performed by core drilling, saw cutting, jackhammering, drilling, piercing (i.e., using powder actuated tools) or demolition.
as-built	Drawings showing utility configurations, as they were known to exist at the completion of the referenced project. These may not be correct, depending on the age of the building.
Authorized Worker	Possesses current, documented safety training as required per the Electrical Safety and Lockout/Tagout (LOTO) Subject Areas.
ground penetrating radar (GPR)	A device that uses radar technology to detect rebar, conduits, post tension cables, and voids in concrete.
ground-fault circuit interrupter (GFCI)	A GFCI constantly monitors the electrical current passing through a circuit. If the amount of current passing into the circuit is different from the current being returned to the circuit, it indicates a ground-fault and the GFCI shuts off the electrical current to the circuit.
non-aggressive concrete and masonry penetrations	Any concrete or masonry penetration less than or equal to 3 inches in depth performed by hand chiseling, or masonry nails driven by handheld hammer, or by drilling with a bit less than or equal to 1 inch in diameter using a mechanical depth stop. Non-aggressive penetration may also include powder actuated piercing only in walls and a penetration of 1 inch or less.
Project Lead	The Project Coordinator, Project Manager, Engineer, Designer, Planner, Planner Estimator, Project Leader, BNL Supervisor, or other BSA personnel who is responsible for the project under which the penetration is to be performed.
utility	Electric, fire alarm, telephone, fiber optic, communication/signal cable, chilled water, compressed air, propane, sewer, steam, storm drains, water, natural gas, facility-specific utilities, off-gas, and process/waste, etc.
utility representative	An employee who is knowledgeable about locations and designs of their respective utility (e.g., electrician, steam fitter).
worker	(For the purposes of this subject area), the personnel physically performing the concrete or masonry penetration.

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What Makes the Penetration Aggressive or Non-Aggressive?

Effective Date: Oct 30, 2014

METHOD	What makes it...	What makes it...
	Aggressive (Aggressive Penetration Permit <u>required</u>)	Non-Aggressive (no Aggressive Penetration Permit required)
Hand Chisel	If over 3 inches in depth	If 3 inches or less in depth
Handheld Power Impact Chisel	In other than hollow block walls OR In hollow block walls where the conditions do not allow for visual confirmation that no utilities are present.	Using a flat bit of 2½ inches or less. Penetration in or behind the hollow block wall after visual confirmation that no utilities are present that would present a hazard to the persons performing the penetration.
Masonry Nails	If over 3 inches in depth	If 3 inches in depth or less
Powder/Gas Actuated Piercing	In <u>other than walls</u> OR Over 1 inch depth	In walls only AND 1 inch or less in depth
Drilling	If over 3 inches in depth OR Over 1 inch in diameter OR Without a mechanical depth stop	If 3 inches or under in depth AND 1 inch or less in diameter AND With mechanical depth-stop
Core Drill	Always	Never
Jackhammer	Always	Never
Demolition	Always	Never
Saw cut	Always	Never

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Questions/Comments

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Management System: [Worker Safety and Health](#)

Subject Area: [Concrete and Masonry Penetrations](#)

Aggressive Concrete and Masonry Penetration Evaluation Procedure/Checklist

Effective Date: Oct 30, 2014

The Aggressive Concrete and Masonry Penetration Evaluation Procedure/Checklist is provided as a [PDF](#) file.

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Building No./Permit No.:	Evaluation Date/Time:
Project Lead:	Other:
F&O Utility Representative:	Other:
FPM/Complex Engineer:	Other:
Contractor/Worker Representative:	Other:

The Project Lead will assemble an appropriate team to review this form on completion of mark-outs in the proposed penetration area. The team is to include at a minimum: Project Lead, Facility Project Manager or Research Space Manager or Complex Engineer, Contractor/Worker responsible for execution of work and/or others deemed necessary by site conditions. This form is to be used as a supplement to the the Concrete and Masonry Penetration Permit.

REQUIRED ACTIONS – CHECK ALL AS COMPLETE

- Verify all areas within 5” of fixed obstructions (walls, pipes, columns, etc.) have been identified as “Not Surveyed”.
- Verify all markings are permanent in nature or substantial enough to stand up to expected wear, traffic, and wet drilling process.
- Review safety margin to be applied to identification of “safe drilling areas” within penetration layout. (2” off centerline of mark outs, both directions, minimum)
- Review all available as-built documentation. (Plans, documentation, utility drawings as applicable)
- Inspect other side of walls, under floors, or within concealed ceilings when possible.
- Layout proposed penetration location(s) within the surveyed area. Evaluators to review floor/wall markings against proposed penetration locations.
- Photo document marked areas for record.
- LOTO all known utilities in the location of the penetration area. (Electric, steam, propane, natural gas)
- Verify use of electrical equipment with GFCI.
- Verify use of all appropriate PPE as identified in procedure. Class 0 (1 kV rated) insulating gloves under leather gloves, Type I, Class 2, electrical safety mat in wet conditions (Type I or II, Class 2 in dry conditions), electrical safety mat or wear electrical safety footwear, rated for use at 1000 volts, nonconductive safety glasses and other PPE as required by the work permit) **Note:** Work performed while on a non-conductive ladder or any type of aerial lift does not require a safety mat or footwear as long as the conditions are dry and non-conductive.
- Verify worker training as per the Electrical Safety Subject Area.
- Verify worker performing the aggressive concrete or masonry penetration(s) is not working alone and must be with at least one other worker that is trained per the Electrical Safety Subject Area while maintaining line of sight at all times.
- Verify the aggressive concrete and masonry penetration permit is authorized.

POSSIBLE ADDITIONAL ACTION(s) – CHECK ALL THAT APPLY

- Sub-surface conflict identified or suspected. If location is not critical, relocate penetration to alternate “safe penetration area”.
- Sub-surface conflict identified or suspected. If location is critical, request 3-D GPR scan of the proposed penetration location and follow-up team evaluation of the 3-D data.
- Sub-surface conflict identified or suspected. If location is critical, require non-aggressive penetration methods (Non-powered hand tools).
- Verify Energized Electrical Work Permit is authorized when not able to LOTO known or suspected utilities in the location of the penetration area.
- Re-evaluate the penetration when there is a ground fault interruption activated during the penetration process.

Management System: [Worker Safety and Health](#)

Subject Area: [Concrete and Masonry Penetrations](#)

Concrete and Masonry Aggressive Penetration Permit

Effective Date: Oct 30, 2014

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