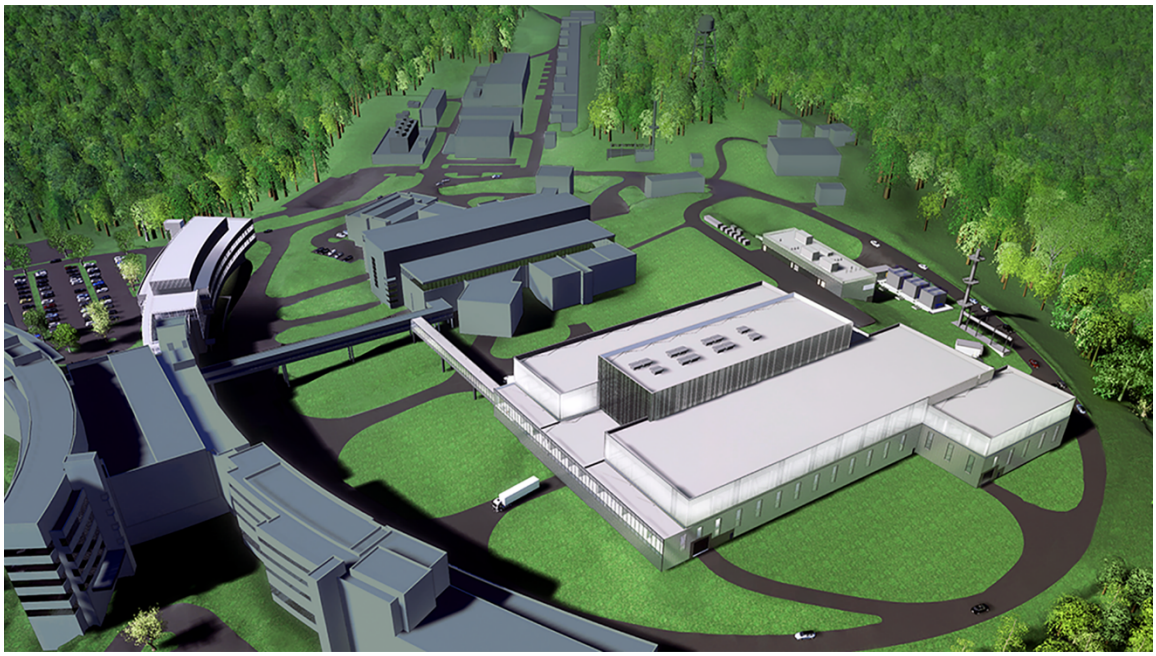
S01030100-ESH10001

STS Natural Phenomena Hazard Basis of Design: STS Seismic, STS Extreme Straight-Line Wind/Tornado, Precipitation/Flood, Lightning, and Snow/Ice/Cold Requirements



December 2023

OAK RIDGE National Laboratory

ORNL IS MANAGED BY UT-BATTELLE LLC FOR THE US DEPARTMENT OF ENERGY

S01030100-ESH10001

Second Target Station Project

STS NATURAL PHENOMENA HAZARD BASIS OF DESIGN: STS SEISMIC, STS EXTREME STRAIGHT-LINE WIND/TORNADO, PRECIPITATION/FLOOD, LIGHTNING, AND SNOW/ICE/COLD REQUIREMENTS

December 2023

Prepared by
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for the
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Approvals

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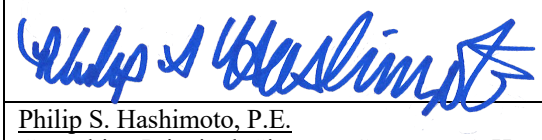
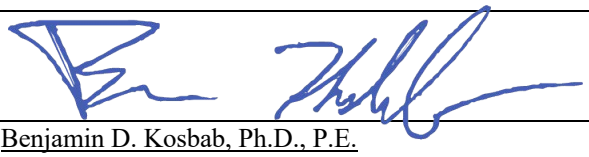
Additional Approvals

We have reviewed the treatments of natural phenomenon hazards in the basis of design and, based on our professional judgement and understanding of the facility and its hazards, find them technically appropriate and consistent with applicable DOE requirements.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CONTENTS

Acronyms

ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
BOD	Basis of Design
CEF	Central Exhaust Facility
CF	Conventional Facilities
CFR	Code of Federal Regulations
CMS	Cryogenic Moderator System
CSB	Central Services Building
DAC	Design Analysis Calculation
DBPL	Design Basis Precipitation Level
DOE	Department of Energy
ESH&Q	Environment, Safety, Health, and Quality
FTS	First Target Station
HOG	Hot Off Gas
HPV	Hot Process Vault
HUR	Hydrogen Utility Room
IBC	International Building Code
LLLW	Low Level Liquid Waste
NDC	NPH Design Category
NFPA	National Fire Protection Association
NPH	Natural Phenomena Hazard
NScD	Neutron Sciences Directorate
ORNL	Oak Ridge National Laboratory
PE	Professional Engineer
PHAR	Preliminary Hazard Analysis Report
PIE	Post Irradiation Examination
PPU	Proton Power Upgrade
PSHA	probabilistic seismic hazard analysis
PPS	Personnel Protection System
QA	quality assurance
QC	quality control
RTST	Ring to Second Target
SDC	Seismic Design Category
SNS	Spallation Neutron Source
SSC	structure, system, or component
STS	Second Target Station
T&I	Target and Instrument
TSB	Tower Support Building
USGS	United States Geological Survey
V&V	verification and validation
WSS	Work Smart Standards

1. INTRODUCTION

The purpose of this document is to establish the natural phenomena hazard (NPH) basis of design (BOD) for structures, systems, and components (SSCs) throughout the Oak Ridge National Laboratory (ORNL) Second Target Station (STS) complex. Because natural phenomena (seismic, extreme straight-line wind/tornado, precipitation/flood, lightning, and snow/ice/cold) are not preventable, associated hazards to the co-located worker, users, and the public, must be addressed in the design of the facility. This BOD identifies codes, standards, and design criteria to mitigate NPH hazards common to any new construction but also to specific hazards unique to the operation of the STS, as identified in *S01030000-ES0002 Second Target Station Project Preliminary Hazard Analysis Report* (PHAR) (reference 9). Only in cases when codes, standards or design criteria are impacted will the PHAR drive changes to this document.

Specific implementation direction for STS SSCs may require development of additional guidance documents to provide relevant detail. Such supplemental guidance documents must, as a minimum, meet the requirements of this BOD and must be approved by the STS Environment, Safety, Health, and Quality (ESH&Q) manager.

2. SCOPE

The basis of design conveyed by this document is limited to mitigation of hazards associated with natural phenomena.

ORNL's Work Smart Standards and the STS Code of Record specify the International Building Code (IBC) - 2018 (reference 4) as applicable. The International Building Code covers every aspect of the design and construction of a facility, including NPH events. This BOD is not a guide to the application or scope of the IBC NPH requirements for the Second Target Station, and shall not be taken to reduce, relax, or omit any portion of the IBC. Adherence to the IBC provides significant protection for NPH and other loading events. The scope of this BOD is limited to clarifying the subset of mitigations from the PHAR where greater than IBC levels of protection are required during NPH events. This BOD uses the methodology and terminology from the IBC to describe the additional levels of protection required for PHAR event mitigation. Satisfaction with the criteria specified in this document is not enough for compliance with the International Building Code, which covers every aspect of the design and construction of a facility and is applicable in its entirety. This document utilizes the IBC, it does not supersede it. The requirements of the IBC must be met (or exceeded) in whole.

3. REGULATORY BASIS

The Department of Energy (DOE) Order 420.1C Chg. 3 *Facility Safety* (reference 1) establishes DOE facility and programmatic safety requirements for nuclear safety design criteria, fire protection, criticality safety, NPH mitigation, and cognizant system engineer programs. Accelerator facilities are noted to be exempt from the nuclear safety design and system engineer program requirements, but not for the other three areas including NPH. This exemption is consistent with the exclusion of accelerators from consideration as nuclear facilities (i.e., Hazard Category 1, 2, or 3) as characterized and governed by Title 10 of the Code of Federal Regulations (10 CFR) Part 830. DOE O 420.1C refers to DOE-STD-1020-2016 *Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities* (reference 2) for NPH criteria in the design of new facilities, including accelerators.

DOE Order 420.2D *Safety of Accelerators* (reference 5) establishes accelerator-specific safety requirements for DOE accelerators, such as the ORNL Second Target Station, that promote safe operations to ensure adequate protection of workers, the public, and the environment. DOE O 420.2D does not include or supplement NPH criteria; the NPH requirements of DOE O 420.1C are applicable.

DOE-STD-1020-2016 provides criteria and guidance for meeting the NPH requirements of DOE O 420.1C that ensure structures, systems, and components in DOE facilities will perform assigned safety functions during and after design basis NPH events and provides requirements and guidance in the use of industry building codes and voluntary consensus standards regarding NPH. DOE-STD-1020-2016 is applicable to all government-owned and government-leased DOE nuclear and non-nuclear facilities and sites. DOE facilities other than Hazard Category 1, 2, and 3 nuclear facilities (i.e., non-nuclear facilities, including radiological facilities) follow section 2.2 of the standard. However, paragraph 1 of this section says "This Section applies to DOE facilities other than Hazard Category 1, 2, and 3 nuclear facilities. These facilities do not have nuclear material above DOE Hazard Category 3 thresholds…". Although the STS is not a Hazard Category 1, 2, or 3 nuclear facility, the STS does have nuclear material above the Hazard Category 3 threshold. Section 2.3 of DOE-STD-1020-2016 applies to Hazard Category 1, 2 and 3 nuclear facilities. This section is not applicable to STS, which is categorized as an accelerator facility. Consequently, neither section 2.2 nor 2.3 is directly applicable. That said, both section 2.2 and 2.3 rely on elements of the International Building Code (IBC) for design criteria to address NPH design of SSCs. Further, Section 2.4.3, which is applicable for all facilities regardless of nuclear versus non-nuclear classification, relies on IBC for NPH evaluation of NDC-1 and NDC-2 SSCs. Therefore, although the specific applicability of different aspects of DOE-STD-1020 to STS SSCs is ambiguous, applying IBC for NPH criteria of STS SSCs is consistent with the framework of DOE-STD-1020, so long as NPH criteria enhancements to account for specific STS radiological hazards and their consequences are also applied (see detail given in section 4 on the subject of the Hazard Analysis basis).

Although DOE-STD-1020-2016 refers specifically to the 2015 edition of the IBC, ORNL Work Smart Standard (WSS) 9 *Engineering Design of Standard Industrial, Radiological, Non-Reactor Category 2 and 3 Nuclear, and Accelerator Facilities* (reference 3) specifies IBC 2018 which in turn cites American Society of Civil Engineers (ASCE) 7-2016 (reference 6) for new facility construction. Therefore, the project will adhere to IBC 2018.

Figure 1, below, illustrates the regulatory basis described in this section.

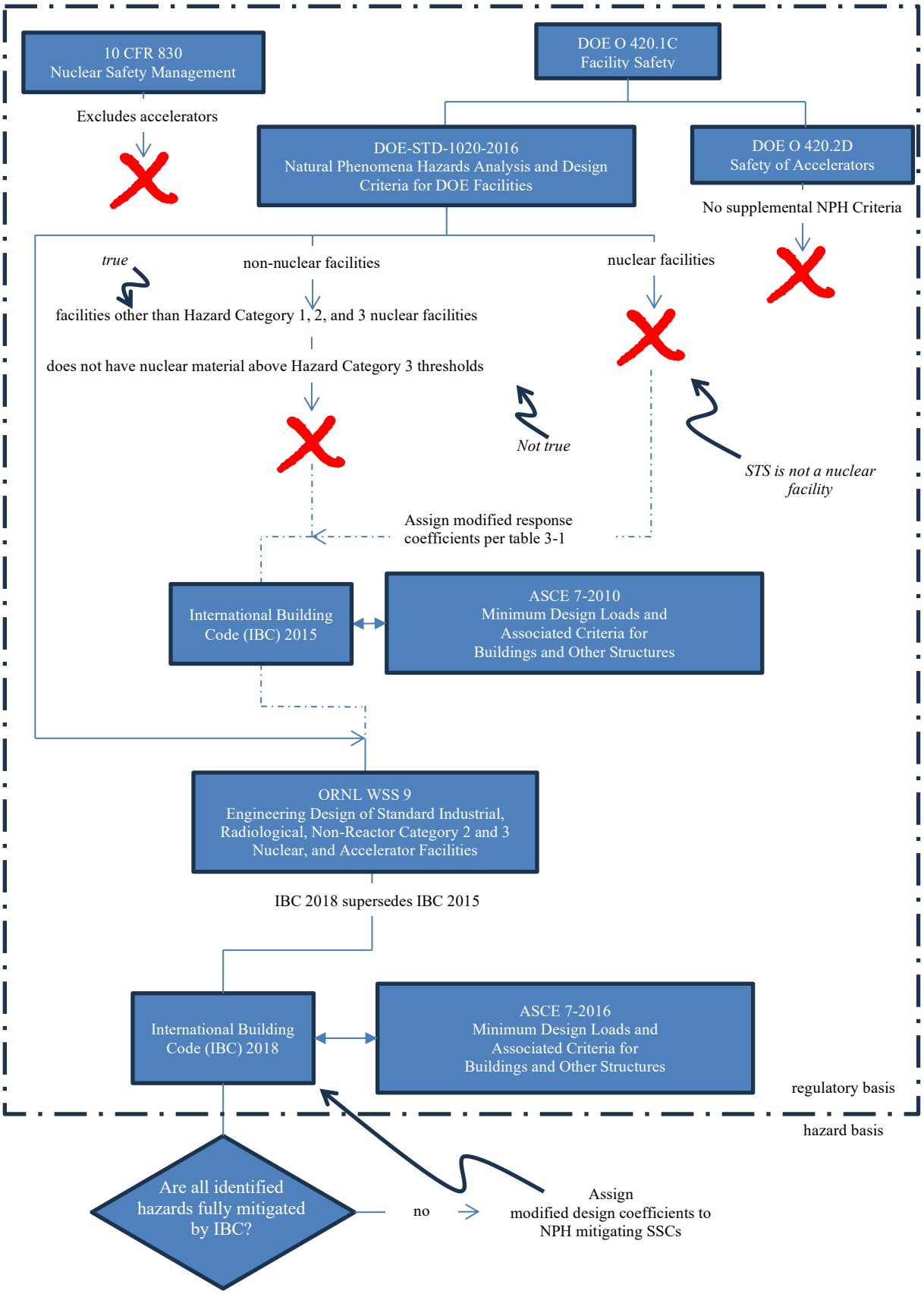

Figure 1. Regulatory basis for the STS project.

4. HAZARD ANALYSIS BASIS

Towards meeting the requirements of DOE O 420.2D, *S01030000-ES0002 Second Target Station Project Preliminary Hazard Analysis Report* provides a qualitative evaluation of the various hazards to workers and the public, particularly those associated with a possibility of radiological release. A number of identified hazards are initiated by external event NPHs, including seismic, tornado, snow, etc. Hazard event evaluations in the PHAR identify two primary types of unmitigated events as bounding for radiological dose exposure to workers or the public. The first is a loss of cooling with continued beam operation (PHAR events AIC3-8, AIC3-9, AIC3-10, AS1-2, BG7-9a, BG7-9b, CMS3-4, CW3-1d, TS3-2, TS3-12), and the second is a seismic event followed by a hydrogen detonation adjacent to the target (PHAR events AIC7-1, BG7-1a, BG7-11, CMS2-4, CMS7-1, CMS7-2, CMS7-4, HB2-1). Conservative evaluations of consequences from the bounding seismic event, documented in *S01030100-PIN10000 STS BG7-1 Working Group Report on the Evaluation of the Estimated Consequences from the Bounding Seismic Event in the STS PHAR* (reference 10) determine maximum dose estimates of <1 rem to the public and ~13 rem to a co-located worker.

Because of the significance of the consequence to the co-located worker from the bounding seismic hazard, modified coefficients and Risk Categories indicated in table 3-1 of DOE-STD-1020-2016 shall be used in conjunction with the International Building Code and associated minimum design load criteria indicated in ASCE 7-2016. For example, based on the estimated consequence to co-located workers and requiring minimal seismic damage, importance factors and response modification coefficients for the STS Target and Instrument Building are substituted for more conservative ones. See Table 1 in section 6 for a list of SSCs with restricted design coefficients.

5. TREATMENT OF NPH REQUIREMENTS FOR CREDITED SSCS

As identified in section 3, DOE O 420.1C Chapter IV requires the design of new facilities to be developed in accordance with the applicable requirements and criteria contained in *DOE-STD-1020-2016 Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities*. As discussed in section 3 of this document, the NPH design of SSCs will follow the criteria of the IBC, which has NPH considerations defined per the ASCE 7 Standard. Because the Target and Instrument Building will contain hazardous material in potentially consequential quantity, it is categorized in the IBC framework as Risk Category IV. However, given the quantified potential dose consequence to workers from bounding NPH events for STS (i.e., ~13 rem), consideration of technical requirements equivalent to those in section 2.3 of DOE-STD-1020-2016 for nuclear facilities is required.

The STS project adopts equivalent supplemental NPH criteria as outlined in DOE-STD-1020-2016 within the overall IBC framework. With such modifications, the SSC performance achieved by compliance with IBC criteria are compatible with their credited functions to mitigate the postulated radiological hazard events.

The STS shall follow the criteria of IBC. Therefore, additional NPH criteria is supplementing, rather than superseding the IBC requirements. The IBC requirements shall be met or exceeded in totality.

6. CREDITED SSC FUNCTION OF MITIGATING DESIGN FEATURES

The STS PHAR identifies credible scenarios and hazard events, qualitatively evaluates their consequences, and selects controls to prevent and mitigate those consequences. For each event, the PHAR identifies: assumptions and initial conditions; causes; unmitigated impact on systems; consequences; safety function; methods of detection; attributes of preventive and mitigative features; planned analysis, assumption validations, and risk/opportunities; and mitigated consequences. The preventative and mitigative features selected to control the event consequences are explicitly identified as being credited. Because many of the

hazard events have NPH initiators, various credited engineered controls and design features relate to providing NPH protection.

SSCs with elevated design criteria are shown in Table 1.

Table 1. SSCs with elevated design criteria.

Structure, System, or Component (**SSC**)	Importance Factor, **I**	Actual (reduced) Response Modification Coefficient, $\mathbf{R_a}$
Target and Instrument Building	1.5	R/1.2 $R_a \geq 1.2$*
Hot Off Gas (HOG) system	1.5	R
Activated Water System	1.5	R
Low Level Liquid Waste (LLLW) Tanks	1.5	R
Local (Post Irradiation and Examination [PIE] and Service Cells) Primary Confinement Exhaust	1.5	R
All hydrogen piping	1.5	R/1.2 $R_a \geq 1.2$*
RTST Tunnel	1.5	1.75

**designer must reduce the max permissible building code R by a factor of 1.2 but need not lower it below R_a=1.2.*

The RTST Tunnel shall be designed as Risk Category IV, I = 1.5, R=1.75 to match the categorization of the directly upstream and contiguous structure of the PPU designed and constructed RTST Stub.

The HOG, Activated Water System, Low Level Liquid Waste Tanks, Local Primary Confinement Exhausts, and hydrogen piping are nonstructural components with seismic design criteria developed according to chapter 13 of ASCE 7-2016, using Table 1's coefficient restrictions, as addressed in section 11.1.1 of this document.

Functionality of the STS after an NPH event means that SSCs must continue to prevent the release of radiation. It does not mean that valves, dampers, instrumentation, pumps, etc. must continue to function as they did before an NPH event.

The balance of the STS shall be designed per IBC-2018/ASCE 7-2016.

7. SELECTION OF IBC EDITION

DOE-STD-1020-2016 refers specifically to the 2015 edition of IBC. The IBC is on a three-year cycle, such that both 2018 and 2021 editions of IBC are now available. Each edition of IBC typically includes the latest versions of referenced standards. For example, IBC-2015 refers to ASCE 7-2010, whereas both IBC-2018 and IBC-2021 refer to ASCE 7-2016. The latest ASCE 7-2022 has not yet been referenced within IBC. Although

NPH criteria in ASCE 7 are continuously evolving and are typically updated each code cycle, each edition of IBC includes the then-current NPH criteria.

The selection of applicable IBC edition is generally the responsibility of the applicable Authority Having Jurisdiction (AHJ). In the case of STS, located on federal land, the AHJ is the DOE, and ORNL more specifically. The ORNL Work Smart Standards (WSS) adopts IBC-2018. While acknowledging that DOE-STD-1020-2016 specifies use of IBC-2015, it permits use of NPH-related requirements from either IBC-2015 or -2018. The STS project will use IBC-2018, not IBC-2015, with one key reason being that ASCE 7-2016 includes significant improvement in the quantification of performance expectations characterized by the seismic design formulations, including continued functionality for Risk Category IV structures and components. This improvement allows better alignment of design criteria with credited performance of features to mitigate hazard events at STS. Another advantage is that commentary to Chapter 26 of ASCE 7-2016 includes consideration for tornado loads (see section 11.2).

8. SEISMIC HAZARD FOR DEVELOPMENT OF DESIGN SPECTRA

Seismic design per IBC defaults to leveraging the national seismic hazard models developed by the United States Geological Survey (USGS) Earthquake Hazards Program to define the seismic design spectra. However, at DOE sites that house nuclear facilities, it is common to have results of a site-specific probabilistic seismic hazard analysis (PSHA) to define the seismic design spectra for SSCs of Seismic Design Category (SDC)-3 and higher.

NPH design criteria shall be per IBC. Although the default within IBC is to develop the design spectra based on USGS national seismic hazard model data, there is an option to use the results of a site-specific PSHA to develop an alternative design spectra (i.e., ASCE 7-2016 Chapter 21). This option requires specific provisions be met regarding how the site-specific PSHA is used. In general, PSHA results are not used directly as design spectra within the IBC framework. The STS Project will use ORNL site-specific PSHA in development of the design spectra for the facility while also complying with the provisions of IBC for doing so. The resulting alternative design spectra may be higher or lower than the standard design spectra but should not be lower than the reduction limitation in IBC without justification.

Had the STS been treated as a nuclear facility, then guidance in DOE-STD-1020-2016 about use of site-specific PSHA results would have been more applicable. Such guidance is in two parts. First, DOE-STD-1020-2016 Footnote 2 suggests that site-specific PSHA should be considered if it exceeds the default IBC spectra by more than 25% at the same return period. Second, DOE-STD-1020-2016 section 3.4.3 permits use of a site-specific PSHA to define site-specific ground motions for SDC-1 and -2 SSCs under certain conditions. Leveraging site-specific PSHA within the IBC framework is consistent with the spirit of this guidance in DOE-STD-1020-2016 while maintaining full compliance with IBC.

9. QUALITY ASSURANCE REQUIREMENTS

QA requirements for the STS project come from the IBC. However, DOE-STD-1020-2016 specifies that *DOE O 414.1D Quality Assurance* is still applicable, requiring verification and validation (V&V) of design software to be performed even for non-nuclear facilities, with guidance provided in DOE-STD-1020-2016 section 10. Had STS been classified as a nuclear facility, then DOE-STD-1020-2016 section 10 would be applicable directly. However, it specifies that for NDC-2 facilities, QA and quality control (QC) requirements of IBC are applicable, supplemented by those from referenced material and design codes and standards where appropriate. For design software, V&V is specified as necessary following a graded approach. In both cases, the QA requirements are effectively the same: IBC QA plus software V&V. For additional direction regarding STS's Quality Assurance Program and its graded approach toward quality see *S01030000-QA0001 STS*

Quality Assurance Plan (reference 12) and *S01030200-PR0002 Quality Level Determination Procedure* (reference 13).

For NDC-3 to NDC-5, note that DOE-STD-1020-2016 reminds that DOE O 414.1D invokes American Society of Mechanical Engineers (ASME) NQA-1 Standard. This is not the case for non-nuclear structures and NDC-2 or lower. Requirements for software V&V should not be confused with implying necessary compliance to ASME NQA-1.

10. STS BUILDINGS[1]

The STS Target and Instrument Building (see Figure 2) shall be designed per the 2018 edition of the International Building Code (IBC) as a Risk Category IV facility with modified response coefficients I = 1.5, Ra = R/1.2, Ra ≥ 1.2, where *I* = Importance Factor; R_a = Actual (reduced) Response Modification Coefficient to be used in the design substituting R values given in ASCE 7-2016, (as previously mentioned in section 6, $R_a = R/1.2$ means the designer must reduce the maximum permissible building code R by a factor of 1.2 but need not lower it below R_a=1.2).

The RTST Tunnel shall be IBC-2018 Risk Category IV, I=1.5, R=1.75.

Requirements associated with Seismic, Extreme Straight-Line Wind/Tornado, Precipitation/Flood, Lightning, and Snow/Ice/Cold design conditions are found in Sections 11.1, 11.2, 11.3, 11.4 and 11.5 respectively.

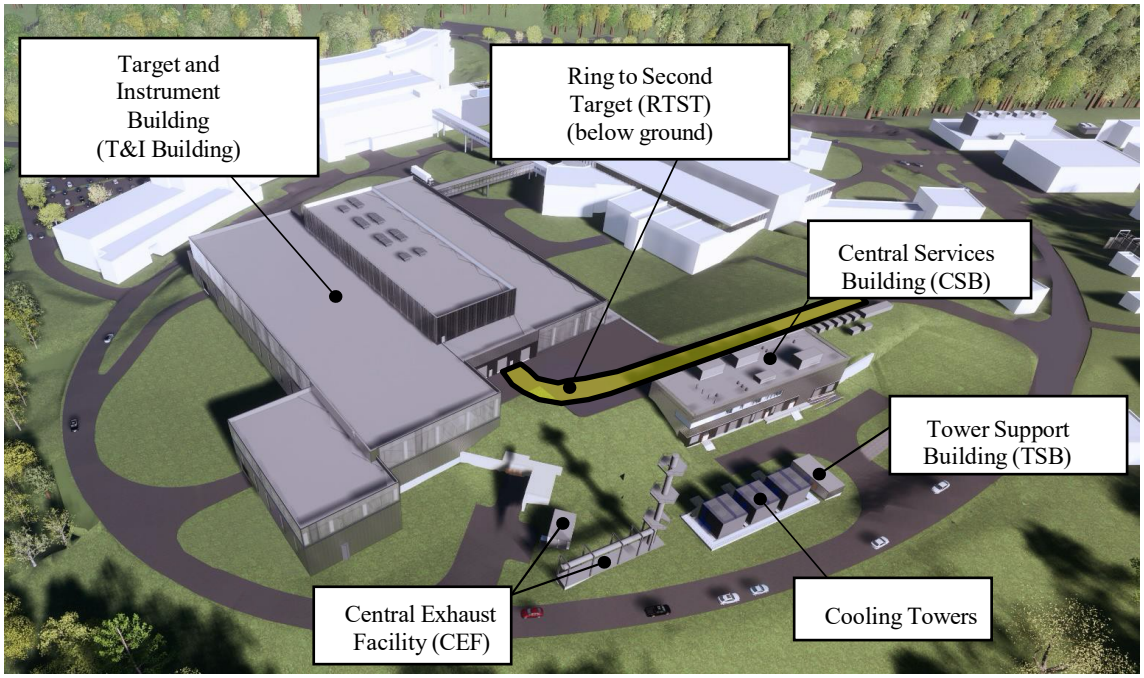

Figure 2. The Chestnut Ridge Campus with STS building scope labels.

[1] The buildings included in the STS project required for the integrated operational STS facility include the Target and Instrument Building addressed in the primary sections of this document as well as additional service buildings that do not contain hazards requiring specific control under the STS Preliminary Hazard Analysis or Safety Assessment Document. These facilities include the Central Services Building, Central Exhaust Facility, the Cooling Towers and Tower Support Building. These facilities are designed to IBC/ASCE 7 requirements and do not have additional NPH requirements. The RTST Tunnel has elevated NPH design criteria to match criteria previously assigned to the RTST stub.

As described below, NPH considerations in the STS project facilities are dominated by the hazards within the Target and Instrument Building and primarily for seismic and straight-line wind/tornado events.

11. STS STRUCTURES, SYSTEMS, AND COMPONENTS

11.1 SEISMIC

As previously mentioned, the STS Target and Instrument Building will be designed according to IBC-2018 and ASCE 7-2016 Risk Category IV, with modified response coefficients I = 1.5, $R_a = R/1.2$, $R_a \geq 1.2$, where I = Importance Factor; R_a = Actual (reduced) Response Modification Coefficient to be used in the design substituting R values given in ASCE 7-2016, ($R_a = R/1.2$ means the designer must reduce the maximum permissible building code R by a factor of 1.2 but need not lower it below R_a=1.2).

This seismic categorization is more rigorous than would be required for standard commercial construction because of the need to satisfy the facility safety driven seismic requirements and specific events identified in the PHAR to provide protection against potential excessive exposure to radiological and/or chemical hazards. The Second Target Station contains several major elements credited with mitigating a post-earthquake release that could exceed co-located worker evaluation guidelines as documented in *S01030100-ES0001 Second Target Station (STS) Project Policy for Selection of Safety Related Credited Controls* (reference 8). Analysis has determined that the consequence for the public (maximally exposed individual) falls below the level of requiring credited controls for seismic events.

The ASCE 7 Seismic Design Category is a function of seismicity of the site and the Risk Category (occupancy class) of the facility. Based on *S05030100-TRT10000 Report of Preliminary Geotechnical Exploration* (reference 11), conducted in 2020, the Risk Category IV buildings (the RTST and the Target and Instrument Building) will be SDC-D (DOE-STD-1020-2016 footnote 2 suggests that site-specific PSHA should be considered if it exceeds the default IBC spectra by more than 25% at the same return period).

11.1.1 Seismic Design Requirements for Nonstructural Components

Nonstructural SSCs must not fail in such a way as to result in a failure of the systems identified in section 6, Table 1.

Chapter 13 of ASCE 7-2016 provides direction for seismic qualification of nonstructural components.

Section 13.1.2 assigns nonstructural components to the same Seismic Design Category as the structure that they occupy or to which they are attached. Note that this is the Seismic Design Category per Chapter 11 of ASCE 7-2016, and not the Seismic Design Category from DOE-STD-1020.

Section 13.1.3 provides criteria for assigning a Component Importance Factor, I_p. Based on these conditions, the following SSCs are assigned an Importance Factor, I_p, and reduced response factors, R_a, per Table 1 in section 6:

- The Hot Off Gas (HOG) system
- The Activated Water System
- Low Level Liquid Waste Tanks
- Local (Post Irradiation and Examination [PIE] and Service Cells) Primary Confinement Exhaust
- All hydrogen piping (in the Cryogenic Moderator System [CMS], Hydrogen Transfer Lines, and the Hydrogen Utility Room [HUR])

Other equipment that, unlike the above list, does not pose a radiological hazard but, meets the conditions of ASCE 7-2016 section 13.1.3 (e.g., fire protection systems and egress stairways), will also require a

Component Importance Factor, I_p =1.5. Such components do not require additional limitations on their response factor, R.

Section 13.1.4 defines exemptions from seismic qualification of nonstructural component requirements. These exemptions include furniture (except for storage cabinets), temporary or movable equipment, components less than 20 lbs (89 N) and distributed systems less than 5 lb/ft (73 N/m). Exemptions from seismic qualification notably do not include nonstructural components weighing more than 400 lb (1,779 N) or have centers of mass greater than 4 ft (1.22M) above the adjacent floor level.

Drawings specifying seismic supports, braces, anchorage, and similar for nonstructural components, as well as Design Analysis Calculations (DACs) for same, per ASCE 7-2016, must be stamped by a Professional Engineer (PE) registered in the state of Tennessee. Note that the drawings and calculations of nonstructural mechanical and electrical components (etc.) are not required to be stamped (unless required by whatever standard governs those specific components). However, the parent or installation drawing which shows the nonstructural component and specifies its seismic anchoring must be stamped by a PE. For example, the manufacturing drawings of an electrical cabinet would not be required to be evaluated or stamped, but a drawing (for example, an installation drawing), showing the cabinet (or family of cabinets) and its seismic restraint(s), and calculations qualifying the seismic restraint, must be prepared and stamped by a PE.

11.2 EXTREME STRAIGHT- LINE WIND/TORNADO

The STS Target and Instrument Building shall be designed for extreme wind-related hazards using the criteria given in IBC-2018 for Risk Category IV facilities. The RTST is below ground and therefore does not require design criteria to mitigate extreme straight-line wind/tornado. Design criteria for the other STS buildings, all of which are Risk Category II, are developed per the IBC.

The PHAR describes a potential tornado related hazard (BG7-4) which, if left unmitigated, could result in a moderate elevated radiological dose to the co-located worker. In order to address this, the Target and Instrument Building shall be designed per the commentary found in Chapter 26 of ASCE 7-16 to minimize building damage (section C26.14.4) for an EF-2 tornado.

11.3 PRECIPITATION/FLOOD

Design criteria for precipitation and flood shall be per IBC-2018.

11.4 LIGHTNING

DOE-STD-2010-2016 requires that applicable SSCs be either (a) designed to withstand the effects of such strikes or (b) protected from strikes in accordance with the criteria of NFPA-780-2020 (reference 7).

In addition to designing to NFPA 780 and the STS specific lightning design functional requirements driven from events in the STS PHAR, the actual specification for the system should call for a UL Master Label certification on the system (a QA criteria).

11.5 SNOW/ICE/COLD

Design criteria for snow/ice/cold for the STS shall be developed according to IBC-2018.

12. REFERENCES

1. DOE Order 420.1C, Change 3, Facility Safety, Nov. 2019
2. DOE-STD-1020-2016, Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities, December 2016
3. ORNL Work Smart Standard (WSS) No. 9, Engineering Design of Standard Industrial, Radiological, Non-Reactor Category 2 and 3 Nuclear, and Accelerator Facilities
4. International Building Code (IBC), 2018
5. DOE Order 420.2D, Safety of Accelerators, September 2022
6. ASCE/SEI 7-2016 Minimum Design Loads and Associated Criteria for Buildings and Other Structures, 2016
7. NFPA-780-2020, Standard for the Installation of Lightning Protection Systems,
8. S01030100-ES0001, R00, Second Target Station (STS) Project Policy for Selection of Safety Related Credited Controls
9. S01030000-ES0002, R02, Second Target Station (STS) Project Preliminary Hazard Analysis Report, January 13, 2023
10. S01030100-PIN10000, R00, STS BG7-1 Working Group Report on the Evaluation of the Estimated Consequences from the Bounding Seismic Event in the STS PHAR
11. S05030100-TRT10000-R00 Report of Preliminary Geotechnical Exploration
12. S01030000-QA0001, R00 STS Quality Assurance Plan
13. S01030200-PR0002, R00 Quality Level Determination Procedure