FermiFORWARD

Document No. 3.1.1250

10CFR851 Pressure Variance

James (Jimmy) Angelos
Transition Manager

FermiForward
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jangelos@fnal.gov

November 6, 2024

Attn: Paul Golan
U. S. Department of Energy
PO Box 2000
Batavia, IL 60510-5011

Subject: 10 CFR 851 Pressure Variance

Mr. Golan,

Enclosed, please find Fermilab's letter regarding the 10 CFR 851 Pressure Safety Variance to reflect the change from FRA, LLC to FermiForward.

There are no changes in processes of implementation. The only required update to the Pressure Variance is to change the operating LLC from Fermi Research Alliance to FermiForward.

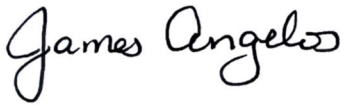
If you have any questions, or require additional information, please contact me at 803-295-3039. Thank you for all your support in implementing a successful transition.

James Angelos

James Angelos
FermiForward Transition Manager

Enclosures: as stated
CC: R. Scott
J. Kirby
M. Andrews
M. Bonkalski
PrimeContractManagement@fnal.gov

REVISION	0
DATE	11/6/24

APPROVED	REVIEWED
	
FFDG Transition Manager	FFDG Transition Lead, WBS Area
James Angelos	Mike Bonkalski

November 4, 2024

Lia Merminga
Director

Office of the Director
P.O. Box 500, MS 200
Kirk Road and Pine Street
Batavia, Illinois 60510-5011
USA

Office: 630.840.3211
merminga@fnal.gov

Mr. Roger Snyder
Site Office Manager
Fermi Site Office
U. S. Department of Energy
P. O. Box 2000
M/S 118
Batavia, Illinois 60510-5011
U. S. A.

Dear Mr. Snyder,

Fermi National Accelerator Laboratory (Fermilab) is upgrading its accelerator complex to provide a minimum one-megawatt proton beam to develop and support a world-class neutrino program. Fermi Forward Discovery Group (FermiForward), as the new M&O contractor, with the DOE, continues to foster the international collaboration and partnerships required to support the design and construction of this world-class science laboratory.

For this type of world-class global science, specialized/custom pressure equipment for superconducting accelerators and one-of-a-kind experimental detectors is required. Development of such equipment and related actions with international partners necessitates the use of international design and safety codes. Title 10 Code Federal Regulation (CFR) Part 851 requires adherence to the set of codes under American Society of Mechanical Engineers (ASME) which includes the Boiler and Pressure Vessel Code (BPVC) and ASME B31 codes for pressure piping and does not recognize the use of international codes in the design and construction of pressure equipment. FermiForward therefore requests a permanent variance from portions of 10 CFR Part 851, as reviewed and recommended by the DOE Office of Environment, Health, Safety, and Security to the Under Secretary for Science and Innovation, dated May 16, 2024. This variance application seeks approval for Fermilab's process to ensure pressure equipment constructed to international codes is As Safe and Healthful As (ASAHA) equipment constructed to the ASME codes.

The attached variance is submitted for your approval. Please reach out to Marc Clay (mclay@fnal.gov) to address any questions or concerns.

Sincerely,

Lia Merminga

Lia Merminga
Director
Office of the Director

cc:	B. Fleming	M. Clay	G. Stephens	M. Andrews
	J. Scott	J. Kerby	J. Niehoff	J. Sawyer
	A. Bihary	M. Kaducak	R. Ray	K. Vetter

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November 4, 2024

Attn: Paul Golan
U. S. Department of Energy
PO Box 2000
Batavia, IL 60510-5011

Subject: 10 CFR 851 Pressure Variance for LBNF/DUNE

Mr. Golan,

Enclosed please find the 10 CFR 851 Pressure Variance at the LBNF/DUNE project for your information.

There are no changes to requirements or implementation. FermiForward is adopting the Pressure Variance as is. The only required update to the Pressure Variance is to change the operating LLC from Fermi Research Alliance to FermiForward.

If you have any questions, or require additional information, please contact me at 803-295-3039. Thank you for all your support in implementing a successful transition.

James Angelos

James Angelos
FermiForward Transition Manager

Enclosures: as stated
CC: R. Scott
J. Kirby
M. Andrews
M. Bonkalski
PrimeContractManagement@fnal.gov

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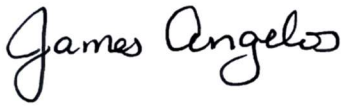	
FFDG Transition Manager	FFDG Transition Lead, WBS Area
James Angelos	Mike Bonkalski

Executive Summary

The United States (US) Department of Energy's (DOE) Fermi National Accelerator Laboratory (Fermilab) is upgrading its accelerator complex to provide a minimum one-megawatt proton beam to develop and support a world-class neutrino program. The program's flagship project is the Long-Baseline Neutrino Facility and Deep Underground Neutrino Experiment (LBNF/DUNE), which, to reach its ambitious physics goals, requires completion of the Proton Improvement Plan II (PIP-II). Fermi Research Alliance (FRA), with the DOE, continues to foster the international collaboration and partnerships required to support the design and construction of LBNF/DUNE and PIP-II.

The DOE's Office of High Energy Physics (HEP) and the Particle Physics Project Prioritization Panel (P5), a subcommittee of the DOE Office of Science's HEP Advisory Panel (HEPAP), have endorsed a global particle physics program. The DOE Office of International Science & Technology Cooperation and Trusted Research guides the overall Office of Science international cooperation and facilitates collaboration with international partners. Several international partners have already received funding to begin the process of upgrading the Fermilab accelerator complex.

For this type of world-class global science, specialized/custom pressure equipment for superconducting accelerators and one-of-a-kind experimental detectors is required. Development of such equipment with international partners necessitates the use of international design and safety codes. Title 10 Code Federal Regulation (CFR) Part 851 requires adherence to the set of codes under American Society of Mechanical Engineers (ASME) which includes the Boiler and Pressure Vessel Code (BPVC) and ASME B31 codes for pressure piping and does not recognize the use of international codes in the design and construction of pressure equipment. FRA therefore requests a permanent variance from portions of 10 CFR Part 851, as outlined in this application, in accordance with 10 CFR Part 851 Subpart D. This variance application seeks approval for FRA's process to ensure pressure equipment constructed to international codes is As Safe and Healthful As (ASAHA) equipment constructed to the ASME codes.

FRA has begun constructing the portion of the LBNF/DUNE project at Sanford Underground Research Facility (SURF) in Lead, South Dakota to house the future DUNE detector modules. FRA has also begun constructing the PIP-II project, starting with the Cryogenics Plant, and soon will begin construction of a new LINAC facility and enclosure. These facilities propose to use non-ASME pressure equipment, that are constructed and provided as in-kind contributions by international partners.

FRA has developed a review and approval process to accept non-ASME pressure equipment.

This variance request is based on FRA demonstrating that the following international codes are ASAHA to the ASME codes.

Country / Member Countries	Description
European Union	Pressure Equipment Directive (PED) compliant codes
Canada	Boiler, Pressure Vessel, & Pressure Piping (CSA B51:19)
United Kingdom	National Pressure Code, PD 5500
Japan	Construction Code for Pressure Vessels (CCfPV)
India	Indian Boiler Regulations (IBR)

Qualified persons[1] (Subject Matter Experts) will review the international code the equipment is constructed[2] to and determine if the codes are ASAHA to the ASME codes. Their conclusion could be the codes are ASAHA (no further action is needed) or a recommendation for compensatory measures to achieve ASAHA. If compensatory measures cannot be used to achieve ASAHA, either because there is no compensatory measure or it is infeasible, then the code and equipment constructed to that code, will not be utilized. This review will be documented by a White Paper.

Once the White Paper is approved by FRA's subject matter experts (SMEs) they will submit the White Paper to the Chief Safety Officer for approval and subsequent submittal to DOE Fermi Site Office (FSO) for notification.

[1] A qualified person is a person who, by possession of a recognized degree or certificate of professional standing and by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work, and therefore can be considered a Subject Matter Expert (SME). A group of qualified people (SMEs) perform an in-depth review and analysis to establish that the level of safety provided in the code is equivalent between international and U.S. codes. Additional qualified person(s) from outside the laboratory may participate in some of the "As Safe and Healthful As" reviews.
[2] ASME BPVC VIII Div. 1, Construction is an all-inclusive term comprising materials, design, fabrication, examination, inspection, testing, certification, and overpressure protection.

Name and address of Contractor & Subcontractors

Fermi Research Alliance, LLC (M&O Contractor)
Wilson and Kirk Roads, P.O. Box 500, MS#105
Batavia, IL, 60510

Name and address of DOE Site or Sites Involved

Fermi National Accelerator Laboratory
Wilson and Kirk Roads, P.O. Box 500
Batavia, IL, 60510

Fermi Research Alliance
(Sanford Underground Research Facility – LBNF-DOE Leased Space)
206 Ellison Ct
City of Lead, SD 57754

Type of variance:

Permanent

A specification of the Standard or Portion thereof, from which the contractor seeks a variance.

§ 851.23(a)(3) Title 29 CFR, Part 1910, “Occupational Safety and Health Standards” the following sections:

- 29 CFR § 1910.103(b)(1)(i) - Hydrogen, Gaseous Hydrogen Systems, Design, Containers; subparagraph 29 CFR § 1910.103(b)(1)(i)(a)(1).
- 29 CFR § 1910.103(c)(1)(i) - Hydrogen, Liquefied Hydrogen Systems, Design, Containers; subparagraph 29 CFR § 1910.103(c)(1)(i)(a).
- 29 CFR § 1910.104(b)(4)(ii) - Oxygen, Bulk Oxygen Systems, Storage Containers, Construction – Liquid; subparagraph 29 CFR § 1910.104(b)(4)(ii).
- 29 CFR § 1910.104(b)(4)(iii) - Oxygen, Bulk Oxygen Systems, Storage Containers, Construction – Gaseous; subparagraph 29 CFR § 1910.104(b)(4)(iii)(a).
- 29 CFR § 1910.106(b)(1)(iv) - Flammable Liquids, Tank Storage, Design and Construction of Tanks, Low Pressure Tanks; subparagraph 29 CFR §
- 1910.106(b)(1)(iv)(b)(2)
- 29 CFR § 1910.106(b)(1)(v) - Flammable Liquids, Tank Storage, Design and Construction of Tanks, Pressure Vessels; subparagraph 29 CFR § 1910.106(b)(1)(v)(b).
- 29 CFR § 1910.169(a)(2) - Air Receivers, General Requirements, New and Existing Equipment; subparagraph 29 CFR § 1910.169(a)(2)(i)

§ 851.27 Materials incorporated by reference and Appendix A(4)(b) Pressure Safety

§ 851.27(d) ASME. American Society of Mechanical Engineers, P.O. Box 2300, Fairfield, NJ 07007. Telephone 800-843-2763, or go to http://www.asme.org

(1) ASME Boilers and Pressure Vessel Codes (BPVC) as follows:

(ii) BPVC.II.A-2015, *Section II - Materials, Part A - Ferrous Material Specifications (Beginning to SA-450),* 2015 edition, issued July 1, 2015; IBR approved for appendix A, section 4, Pressure Safety;
(iii) BPVC.II.A-2015, *Section II - Materials, Part A - Ferrous Material Specifications (SA-451 to End),* 2015 edition, issued July 1, 2015; IBR approved for appendix A, section 4, Pressure Safety;
(iv) BPVC.II.B-2015, *Section II - Materials, Part B - Nonferrous Material Specifications,* 2015 edition, issued July 1, 2015; IBR approved for appendix A, section 4, Pressure Safety;
(v) BPVC.II.C-2015, *Section II - Materials, Part C - Specification for Welding Rods; Electrodes, and Filler Metals;* 2015 edition, issued July 1, 2015; IBR approved for appendix A, section 4, Pressure Safety;
(vi) BPVC.II.D.C-2015, *Section II - Materials, Part D - Properties (Customary);* 2015 edition, issued July 1, 2015; IBR approved for appendix A, section 4, Pressure Safety
(vii) BPVC.II.D.M-2015, *Section II - Materials, Part D - Properties (Metric);* 2015 edition, issued July 1, 2015; IBR approved for appendix A, section 4, Pressure Safety;
(xx) BPVC.IV-2015, *Section IV, Rules for Construction of Heating Boilers;* 2015 edition, issued July 1, 2015; IBR approved for appendix A, section 4, Pressure Safety;
(xxi) BPVC.V-2015, *Section V, Nondestructive Examination;* 2015 edition, issued July 1, 2015; IBR approved for appendix A, section 4, Pressure Safety;
(xxii) BPVC.VI-2015, *Section VI, Recommended Rules for the Care and Operation of Heating Boilers;* 2015 edition, issued July 1, 2015; IBR approved for appendix A, section 4, Pressure Safety;
(xxiv) BPVC.VIII.1-2015, *Section VIII - Rules for Construction of Pressure Vessels, Division 1;* 2015 edition, issued July 1, 2015; IBR approved for appendix A, section 4, Pressure Safety;
(xxv) BPVC.VIII.2-2015, *Section VIII - Rules for Construction of Pressure Vessels, Division 2, Alternative Rules;* 2015 edition, issued July 1, 2015; IBR approved for appendix A, section 4, Pressure Safety;
(xxvi) BPVC.VIII.3-2015, *Section VIII - Rules for Construction of Pressure Vessels, Division 3, Alternative Rules for Construction of High Pressure Vessels;* 2015 edition, issued July 1, 2015; IBR approved for appendix A, section 4, Pressure Safety;
(xxvii) BPVC.IX-2015, *Section IX - Welding, Brazing and Fusing Qualifications, Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators;* 2015 edition, issued July 1, 2015; IBR approved for appendix A, section 4, Pressure Safety;
(xxviii) BPVC.X-2015, *Section X, Fiber - Reinforced Plastic Pressure Vessels;* 2015 edition, issued July 1, 2015; IBR approved for appendix A, section 4, Pressure Safety;
(xxx) BPVC.XII-2015, *Section XII, Rules for Construction and Continued Service of Transport Tanks;* issued July 1, 2015; IBR approved for appendix A, section 4, Pressure Safety;

(xxxi) BPVC.CC.BPV-2015, *Code Cases, Boilers and Pressure Vessels;* 2015 edition, issued July 1, 2015; IBR approved for appendix A, section 4, Pressure Safety; and

(2) ASME B31 codes for pressure piping as follows:

(i) B31.1-2016, *Power Piping, ASME Code for Pressure Piping, B31,* issued June 30, 2016; IBR approved for appendix A, Section 4, Pressure Safety;
(ii) B31.3-2014, *Process Piping, ASME Code for Pressure Piping, B31,* issued February 27, 2015; IBR approved for appendix A, Section 4, Pressure Safety;
(iv) B31.5-2016, *Refrigeration Piping and Heat Transfer Components, ASME Code for Pressure Piping, B31,* issued June 29, 2016; IBR approved for appendix A, Section 4, Pressure Safety;
(vii) B31.9-2014, *Building Services Piping, ASME Code for Pressure Piping, B31,* issued April 28, 2014; IBR approved for appendix A, Section 4, Pressure Safety; and
(viii) B31G-2012, *Manual for Determining the Remaining Strength of Corroded Pipelines, Supplement to ASME B31 Code for Pressure Piping,* issued October 24, 2012; IBR approved for appendix A, Section 4, Pressure Safety.

A description of the steps that the contractor has taken to inform the affected workers of the application, which must include giving a copy thereof to their authorized representative, posting a statement, giving a summary of the application, and specifying where a copy may be examined at the place or places where notices to workers are normally posted:

All affected workers and stakeholders have been provided a memorandum informing the stakeholders and workers of the variance request and proposed changes which includes the ability to request additional information related to the variance. Affected employees will be offered the opportunity to ask questions of their management related to the variance, or request a private meeting with their management, or ES&H personnel.

A notice has been issued to all FRA engineers via email and posted in the daily Fermilab newsletter. In addition, the variance request has been discussed in the Mechanical and Cryogenic Safety Subcommittees. The memorandum notice has been created and is available upon request.

A link to the variance application document has been posted on the Fermilab's Environment Safety & Health Division's internal webpage at Fermilab's ES&H document management system.

A description of how affected workers have been informed of their right to petition the EHSS Director or designee for a conference:

All FRA personnel, users, affiliates, and subcontractor workers participating in these activities are informed of their right to petition the EHSS Director through a means of a memorandum. The memorandum will detail the requirements of 10 CFR Part 851 Subpart D as follows.

> (a) Within the time allotted by a notice of the filing of an application, any affected contractor or worker may file with the EHSS Director a request for a conference on the application for a variance.
> (b) A request for a conference filed pursuant to paragraph (a) of this section must include:
>
> > (1) A concise statement explaining how the contractor or worker would be affected by the variance applied for, including relevant facts.
> > (2) A specification of any statement or representation in the application, which is denied, and a concise summary of the evidence that would be adduced in support of each denial; and
> > (3) Any other views or arguments on any issue of fact or law presented.
>
> (c) The EHSS Director, or designee, must respond to a request within fifteen days and, if the request is granted, indicate the time and place of the conference and the DOE participants in the conference.

This process is explained in the memorandum distributed to all affected workers and their supervisors. FRA management will also verbally present the details of the memorandum to all affected workers through meeting(s). Affected employees will be offered the opportunity to ask questions of their management related to the variance, or request a private meeting with their management, or ES&H personnel. The memorandum will also be posted in centralized areas where workers' information boards are located. The memorandum is also posted on Fermilab's ES&H internal document management system.

The notification memorandum details how workers can request a copy of the variance from FRA's Chief Safety Officer. FRA will provide the copy of the variance and offer an opportunity to discuss and answer questions.

Any requests for a conference:

Notice has been posted and workers advised of their right to request a conference. FRA will advise DOE FSO if it receives a request for a conference.

A description of the conditions, practices, means, methods, operations, or processes used or proposed to be used by the contractor:

Background

Safety and hazard evaluations of pressure systems need to consider the consequences of a failure. Complete pressure vessel ruptures can be categorized as: (1) blast effect due to the sudden expansion of the pressurized fluid and (2) consequential damage and injury caused by fragments if a fragmentation-type rupture occurs. A leak failure can include a wide range of consequences, from no effect to very serious depending on the medium contained in the vessel or system (National Institute of Standards & Technology, 1990).

10 CFR 851.27(d)(1) and (2) incorporates by reference sections of the ASME BPVC and ASME B31 codes for pressure piping and does not allow conformance to an international code. FRA has developed a process to evaluate and verify the international construction code is ASAHA the requirements in 10 CFR Part 851 and provides pressure equipment in the workplace that is ASAHA workplaces with pressure equipment that is those designed, fabricated, tested, and inspected in accordance with applicable ASME standards.

Process

FRA will ensure ASAHA through utilization of the steps outlined below.

The Fermilab Cryogenics and Mechanical Safety Subcommittees are comprised of SMEs in pressure safety. This ASAHA process utilizes the Cryogenics and Mechanical Safety Subcommittees to create and review a White Paper, see Figure 1 for additional details of the process.

The White Paper is a technical analysis of the ASME codes and international codes evaluating the seven attributes and sub-attributes listed below. The White Paper will include a conclusion by SMEs for each attribute and sub-attribute. When there are differences between attributes the SME will provide technical reasoning behind their conclusions and provide recommendations if needed. Their conclusion could be no further action is needed because the codes are ASAHA or a recommendation for compensatory measures. A compensatory measure is used to correct a deficiency in the international code to ensure the equipment is ASAHA. If compensatory measures cannot be used to achieve ASAHA, either because there is no compensatory measure or it is infeasible, then the code and equipment constructed to that code, will not be utilized.

A White Paper will include:

(1) Abstract including the international code or standard being evaluated
(2) Placeholder for concurrence and approval signatures
(3) List of Cryogenics and Mechanical Safety subcommittee members and consultants (SMEs) and their roles
(4) Goals
(5) Technical Analysis
(6) Findings & Recommendations
(7) Conclusions
(8) References and supporting documents
(9) Period of Review

The White Paper will provide recommendations to the Chief Safety Officer and will be signed by all SMEs. The White Paper will identify the next period of review. The review will evaluate changes to the ASME codes and the international codes. A technical analysis will be reperformed by the SMEs commensurate with the identified impact and rerouted for approval. The White Paper will be retained in the ES&H internal document management system.

ASME Seven Attributes for Construction of Pressure Equipment

The following seven attributes and sub-attributes will be included in the technical analysis of the White Paper. The seven attributes and sub-attributes are as follows:

A. Materials
The key attributes for materials are:
a. Listed materials (base metals, weldments, bolts)
b. Allowances for unlisted materials.
c. Responsibility for material selection and corrosion allowances.
d. Material used within the lower temperature limits.
e. Material used within the maximum temperature limits.
f. Unknown or reclaimed materials used within allowances.
g. Toughness requirements.
h. Elevated temperature material testing.
i. Allowance for brittle materials.
j. Suitability of non-metallic materials.
k. Qualification of material suppliers.
l. Quality control of materials.
m. Material traceability.
n. Material test reports.

B. Code design

The key attributes for design are:

a. Scope exclusions and boundaries of the vessel or piping.
b. Qualifications of the designer.
c. Selection of the design pressure and temperature.
d. Allowances for over-pressure and over-temperature.
e. Loads to be considered in the design.
f. Margins of basic allowable stress against ultimate and yield.
g. Burst prevention design.
h. Allowance for pressure design by proof testing.
i. Allowance for layered vessels.
j. Special rules for the design of heat exchangers.
k. Plastic instability prevention design.
l. Fatigue cracking prevention design.
m. Buckling prevention design.
n. Bearing stress failure prevention.
o. Margins on stress limits for load combinations.
p. Weld joint efficiency factors.
q. External pressure design.
r. Nozzle reinforcement design.
s. Permitted and prohibited weld details.
t. Allowances and prohibitions for types of mechanical (non-welded) joints.
u. Design of flanges and bolted joints.
v. Bolting design.
w. Design of cladding and weld overlays.
x. Design of blanks and flat heads.
y. Design of catalog specialty items.
z. Design of support structures.
aa. Allowance for design by finite element analysis, and stress or strain limits.
bb. Fracture mechanics in design, flaw tolerance.
cc. Graded approach to design based on consequence of failure.
dd. Design of closures.
ee. Design of windows.
ff. Design of vessel internals.
gg. Design of attachment to the support structure.
hh. Design of support structures.

C. Fabrication

The key attributes for fabrication are:

a. Welding program.

b. Welding procedure.
c. Welding procedure qualification including coupon testing.
d. Welder or weld operator qualification.
e. End preparation.
f. Permitted and prohibited weld details.
g. Heat treatment.
h. Temper bead welding.
i. Backing rings.
j. Strength of welds.
k. Toughness of welds.
l. Brazing and soldering allowances and conditions.
m. Pre-heating.
n. Post-weld heat treatment.
o. Allowances for weld repairs.
p. Attachment welds.
q. Bending and forming.
r. Fabrication tolerances.
s. Bolting.
t. Mechanical joining.
u. Material segregation.
v. Cleaning.

D. Examination

The key attributes for examination are:

a. Qualifications of NDE personnel.
b. Extent and percent of examinations of welds.
c. Method of examination of welds and acceptance criteria.
d. Graded approach to examination based on consequence of failure.
e. Graded approach to examination based on weld joint efficiency in design.
f. Allowance for spot examination.
g. Allowance for in-process examination.
h. Allowances for weld non-conformance, progressive sampling, and weld repairs.
i. Extent and percent of examinations of mechanical joints.
j. Method of examination of mechanical joints and acceptance criteria.

E. Testing

The key attributes for testing are:

a. Pressure testing requirements.
b. Test method, duration, pressure, procedure.
c. Acceptance criteria for pressure test.

d. Externally pressured components.
e. Sensitive leak testing allowance.
f. Allowance criterion for sensitive leak testing.
g. Allowance to repair leaks.
h. In-shop testing, subassembly testing, and installed testing.
i. Testing of jacketed vessels and piping.
j. Responsibility for functional testing.
k. Cleaning, drying, isolating, storing after testing.

F. Over-Pressure Protection

The key attributes of over-pressure protection are:

a. Over-pressure scenarios, definition of credible over-pressure events.
b. Permitted amount of over-pressure prior and during relief.
c. Allowance for over-pressure protection by system design.
d. Allowance for pressure accumulation.
e. Use of certified relief devices.
f. Placement of the relief device.
g. Hydraulic parameters for the sizing of the relief device.
h. Selection and sizing of the relief device.
i. Allowance for non-reclosing relief device.

G. Inspections and Certifications

The key attributes of inspection and certification are:

a. Requirement for formal Quality Control and Quality Assurance programs.
b. Review of QC and QA programs, and certification to supply, design, and fabricate.
c. Requirement for an independent inspector, and exceptions if any.
d. Responsibilities of the authorized inspector.
e. Qualifications of the authorized inspector.
f. Allowance for self-certification of inspections.
g. Qualifications and audits of material supplier.
h. Qualifications and audits of designer.
i. Qualifications and audits of fabricator.
j. Responsibilities of the Owner, the designer, the fabricator.
k. Authorized inspectors and notified body responsibilities and independence.
l. Materials records.
m. Design records, including drawings.
n. Fabrication records.
o. Examination records.
p. Test records.

q. Over-pressure protection.
r. Approval of records.
s. Certification of records.
t. Retention of records.
u. Stamping or other physical evidence of compliance.

The White Paper is a technical analysis between the codes utilizing the seven attributes and sub-attributes. The following scenarios could result from the White Paper:

1) ASAHA is established between codes on all seven attributes and sub-attributes without any meaningful differences.
2) ASAHA is established between codes on all seven attributes and sub-attributes with differences addressed with a written conclusion based on technical reasoning.
3) Compensatory measures are established and implemented to address the differences between attributes and sub attributes to achieve ASAHA.
4) ASAHA cannot be established between the codes, equipment will not be accepted or constructed, and codes will not be utilized.

Compensatory measures, related to item 3, will be determined by completing additional risk analysis, such as What-if-Analysis or Failure Mode Effects Analysis.

The following is a list of potential compensatory measures:

- Proof test per ASME BPVC VIII Div. 1 UG-101.
- Borescope examination.
- Helium leak testing.
- Certified Mill Test Reports and Certificates of Conformance per published industry consensus standards.
- Material verification (e.g., X-ray fluorescence).
- Material thickness verification (e.g., ultrasonic measurement).
- Finite Element Analysis per ASME BPVC VIII Div. 2 Part 5.
- Reduced basic allowable stress or increased load factor.
  - *Note*: Design margin ≥ 10 against ultimate tensile strength to be applied to brittle or potentially brittle materials.
  - *Note*: Brittle materials exhibit elongation before rupture at less than 14% over design temperature range.
- Reduced component pressure-temperature ratings.
- Reduced weld joint efficiency.
- Increased weld joint inspection and examination.
- Liquid Nitrogen (LN_2) thermal shocking.

- Destructive testing of base material, heat affected zones, and weld joints (e.g., Charpy impact testing).
- Non-destructive testing of material properties (e.g., measuring ferrite to ensure toughness at low temperature in austenitic stainless steels).
- Increased failure probability included in Oxygen Deficient Hazard (ODH) analysis.
- Oxygen deficiency monitoring, activated ventilation, activated alarms, and Fermilab fire department response.
- Smoke and/or flammable gas detection monitoring and activated alarms, and Fermilab fire department response.
- Secondary barrier and/or containment (e.g., insulating vacuum jacket).
- Following American Petroleum Institute (API) Standard 510 procedure for existing vessels with minimal documentation.
- Strain gauge monitoring during testing.
- Safety Instrumented System as additional layer of protection to pressure relief device(s).
- Locating equipment in unmanned controlled access areas.

Roles and Responsibilities

ASME defines “owner” as the person, partnership, organization, or business ultimately responsible for design, construction, operation, and maintenance of pressure systems. ASME also defines a Pressure System Designer, or Engineer, as the person responsible to the owner for assurance that the engineering design of pressure systems complies with the requirements of the code and with any additional requirements established by the owner. In accordance with DOE Order 440.1B, Chg. 4, DOE Field Elements are required as the ASME Owner to implement a comprehensive pressure system safety program.

Roles and responsibilities are essential to implement the practices, means, methods, processes, and operations of this variance. The following defines the roles and responsibilities of those entities and individuals.

- DOE FSO (ASME Owner)
  - Has the authority to assign the operational responsibilities of ASME Owner to FRA.
  - Has the authority to perform assessments of the pressure safety program, including implementation of the variance, as part of their oversight responsibilities.

- FRA Chief Safety Officer or designee

  - Responsible for the final approval of the White Papers and notification to DOE FSO.
  - Deputy Chair of the Fermilab ES&H Committee (FESHCom) [3].

- FESHCom
  - Chair is the laboratory director, and the deputy chair is the Chief Safety Officer.
  - Responsible for reviewing safety and security policies and programs and reporting findings and recommendations to the laboratory director.
  - Responsible for creating safety subcommittees.
  - Responsible for assigning safety subcommittee chairs.
  - The chair is responsible for ensuring the White Papers are reviewed no less than every three years, to ensure the code comparison remains correct or is updated if either code has been revised.

- Cryogenics and Mechanical Safety Subcommittees
  - Chairperson for each subcommittee will request SMEs to form an ad hoc group and may retain the services of outside engineering consultant to develop the White Paper.
  - SMEs within the ad hoc group will perform the technical analysis of the code comparison which is documented in the White Paper.
  - Ad hoc group will submit the White Paper to the Chairpersons to distribute to the full subcommittees for review.
  - All subcommittees' members approve and sign the White Paper.
  - The Chairpersons will submit the approved White Paper to the Chief Safety Officer.

Approval process

The ad hoc group, within the Cryogenics and Mechanical Safety subcommittees, will perform a technical analysis of the code comparison to establish ASAHA. Once they have established ASAHA, documented by the White Paper, the Chairpersons will distribute the White Paper to the entire subcommittee for review, approval, and signature. The Chairpersons will then submit the White Paper to the Chief Safety Officer for approval and subsequent submittal to DOE FSO for notification.

[3] The purpose of FESHCom is to serve as a forum to help assure Fermilab and the Department of Energy that sufficient internal control and oversight systems are in place and are operating properly with respect to the management and operation of ES&H aspects of Fermilab.

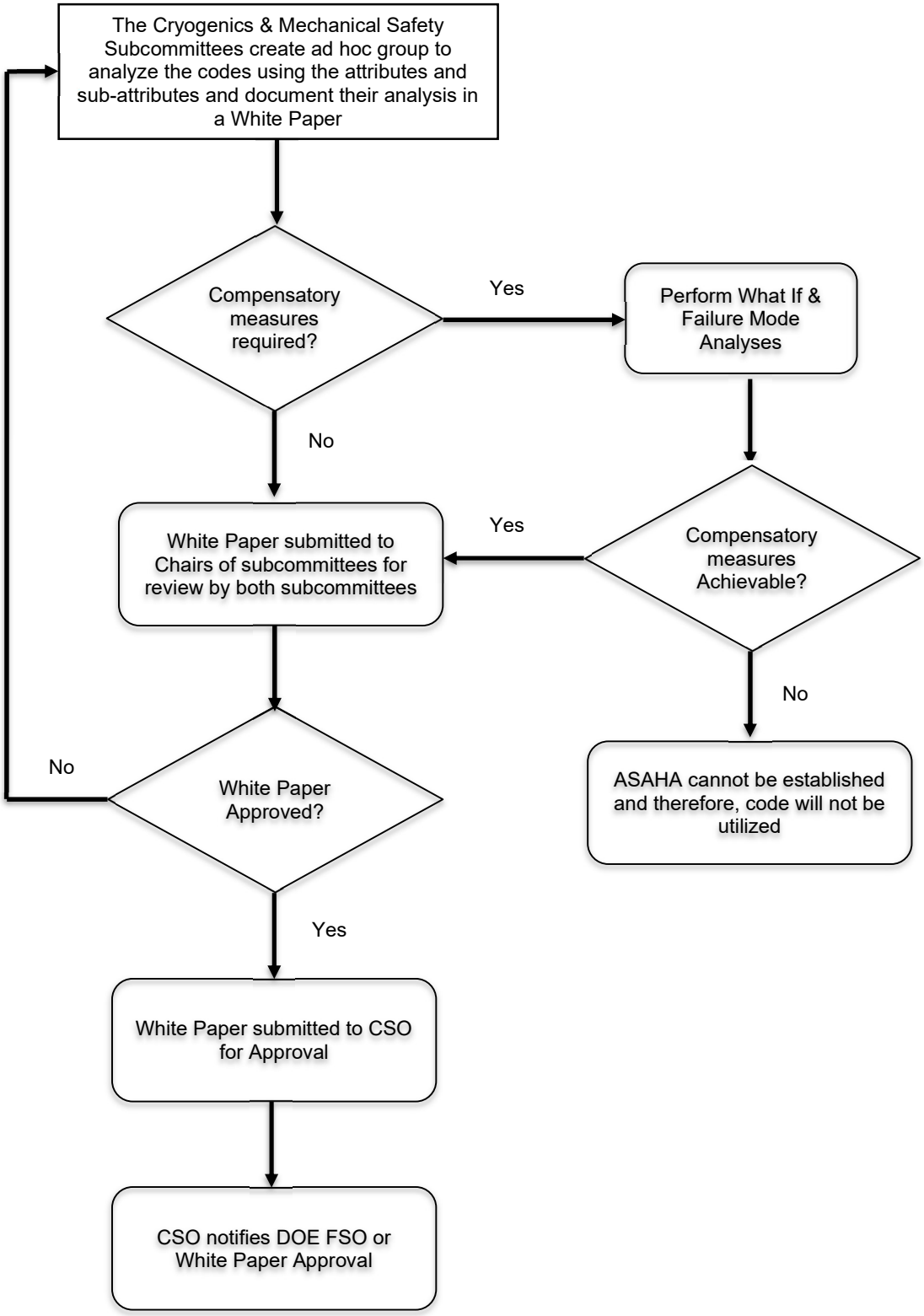

Figure 1 Process flow for accepting “as safe and healthful as” in safety performance.

A statement showing how the conditions, practices, means, methods, operations, or processes used or proposed to be used would provide workers a place of employment which is as safe and healthful as would result from compliance with the standard from which a variance is sought:

The FRA Worker Safety and Health Program establishes ASAHA in accordance with 10 CFR Part 851 by developing a White Paper presenting evidence that the safety of personnel operating equipment constructed to an international code is ASAHA the same equipment if constructed to the ASME codes. Pressure equipment constructed per international codes that is ASAHA provides an equivalent level of safety and protection for personnel as the pressure equipment constructed per ASME codes.

The White Paper will be written by SMEs and once ready for review, the White Paper will be discussed and reviewed by the Cryogenic and Mechanical Subcommittees. The FESHCom Subcommittee Chair(s) are responsible for organizing feedback from their committees and delivering the feedback to the authors of the White Paper. When the White Paper is approved by the Cryogenics and Mechanical Safety Subcommittees, the Chairs will submit the White Paper to the Chief Safety Officer for approval and subsequent submittal to DOE FSO for notification.

The ASAHA process along with this variance will be referenced in the Fermi National Accelerator Laboratory Worker Safety and Health Program in accordance with 10 CFR § 851.11.

References

National Institute of Standards & Technology. (1990). *Guidelines for Pressure Vessel.* NIST Special Publication 780.

Department of Energy
Office of Science
Washington, DC 20585

November 20, 2024

MEMORANDUM FOR TODD LAPOINTE
DIRECTOR
OFFICE OF ENVIRONMENT, HEALTH, SAFETY
AND SECURITY

FROM: JUSTON K. FONTAINE
DEPUTY DIRECTOR FOR OPERATIONS
OFFICE OF SCIENCE

Juston K. Fontaine Digitally signed by Juston K. Fontaine Date: 2024.11.20 08:41:46 -05'00'

SUBJECT: Request for Review on a Title 10 Code of Federal Regulations 851, Worker Safety and Health Program, Permanent Variance for Fermi Forward Discovery Group

ISSUE: Fermi Forward Discovery Group (FermiForward), the selected Management and Operating contractor for Fermi National Accelerator Laboratory (Fermi), effective January 1, 2025, submitted a request to the Office of Science (SC) for a permanent variance to Title 10 Code of Federal Regulations (CFR) 851, "*Worker Safety and Health Program.*"

BACKGROUND: FermiForward requests to use a FermiFoward internal process to provide a comprehensive technical analysis of non-American Society of Mechanical Engineers (ASME) designed/built pressure equipment/systems in lieu of requirements in:

§851.23(a)(3) Title 29 CFR, Part 1910
§851.27(d)(1) ASME Boilers and Pressure Vessel Codes and
§851.27(d)(2) ASME B31 codes for pressure piping

This variance request uses the same base and process that the Fermi Research Associates and received a Department of Energy approval on May 22, 2024. The process is institutionalized within the applicable chapters of the Fermilab Engineering Manual, the Fermilab Environmental Safety & Health Manual, and the Fermilab Quality Assurance Manual. These three documents support the process outlined within the variance to provide the framework to assure that non-ASME designed/built equipment can be operated in a safe manner with the same level of protection that would be achieved when built to ASME requirements and have not changed since the May 22, 2024, approval.

SENSITIVITIES: None.

POLICY IMPACT: None.

URGENCY: SC has reviewed the documentation provided by FermiFoward and concurs on the request for a variance. Per 10 CFR 851, the Chief Health, Safety, and Security Officer needs to review and make a recommendation to the Under Secretary for Science and Innovation on the variance. I have attached the FermiForward submittal and

request for a variance along with supporting documentation. I will also coordinate with the Under Secretary to provide information from SC.

Please contact the Fermi Site Office Manager, Roger Snyder at (630) 840-2304 or the Office of Science Central Technical Authority, Joanna Serra at (240) 252-8758, if you have any questions regarding this matter.

Attachments

10CFR851 Pressure Variance for LBNF/DUNE
10CFR851 Pressure Variance

cc:
J. Halse, DDO
J. Serra, DDO
R. Snyder, FSO
S. Wallace, FSO
J. Dillard, AU-11

Department of Energy
Washington, DC 20585

December 4, 2024

MEMORANDUM FOR UNDER SECRETARY FOR SCIENCE AND INNOVATION

FROM: TODD N. LAPOINTE
DIRECTOR
OFFICE OF ENVIRONMENT, HEALTH, SAFETY AND SECURITY

SUBJECT: **ACTION:** Approval of a permanent variance from certain requirements related to pressure safety in Title 10 CFR Part 851, *Worker Safety and Health Program*, conditioned on the fulfillment of the process described in the application from Fermi Forward Discovery Group

ISSUE: Whether to approve an application by Fermi Forward Discovery Group (FermiForward) for a permanent variance from certain pressure safety provisions of Title 10, Code of Federal Regulations, Part 851, *Worker Safety and Health Program* (10 CFR 851), to use a process that will ensure pressure equipment constructed to certain international codes is as safe and healthful as equipment constructed to the American Society of Mechanical Engineers (ASME) codes.

BACKGROUND: FermiForward, the selected management and operating contractor for Fermi National Accelerator Laboratory, effective January 1, 2025, submitted a request for a permanent variance to the following 10 CFR 851 requirements related to pressure safety:

- Appendix A(4)(b)(1)(ii-vii, xx-xxii, xxiv-xxviii, xxx-xxxi)
- Appendix A(4)(b)(2)(i, ii, iv, vii, viii)
- §851.23(a)(3) [§1910.103(b)(1)(i)(a)(1), §1910.103(c)(1)(i)(a), §1910.104(b)(4)(ii), §1910.104(b)(4)(iii)(a), §1910.106(b)(1)(iv)(b)(2), §1910.106(b)(1)(v)(b), §1910.169(a)(2)(i)]
- §851.27(d)(1)(ii-vii, xx-xxii, xxiv-xxviii, xxx-xxxi)
- §851.27(d)(2)(i, ii, iv, vii, viii)

The request adopts, in whole, the permanent variance application by Fermi Research Alliance (FRA) that was approved by the Department of Energy on May 22, 2024. The process, developed and institutionalized by FRA, evaluates and verifies that certain international pressure vessel and piping construction codes are as safe and healthful as the ASME boiler and pressure vessel codes and ASME B31 codes for pressure piping, prescribed by 10 CFR 851.

Pursuant to §851.31, the Office of Science (SC) Deputy Director of Operations has concurred with the variance application and forwarded it to the Director of the Office of Environment, Health, Safety and Security (EHSS Director) to review and make a written recommendation to the Under Secretary for Science and Innovation for consideration of final approval.

Based on the information provided in the variance application, I agree with the SC Deputy Director for Operations that the permanent variance application submitted by FermiForward should be approved (attachment), provided the conditions outlined in the Justification section are met.

JUSTIFICATION: The permanent variance application submitted by FermiForward is substantively identical to FRA's application previously approved on May 22, 2024. All 10 CFR 851 variance requirements are met, except:

> *§851.31(c)(4) A description of the steps that the contractor has taken to inform the affected workers of the application, which must include giving a copy thereof to their authorized representative, posting a statement, giving a summary of the application and specifying where a copy may be examined at the place or places where notices to workers are normally posted; and*
>
> *§851.31(c)(4) A description of how affected workers have been informed of their right to petition the EHSS Director or designee for a conference.*

These requirements have not yet been met by FermiForward due to the upcoming transition, scheduled for January 1, 2025. EHSS recommends approval, with conditions, to ensure that affected workers not previously informed under the FRA permanent variance application process are informed of the variance and of their right to petition for a conference.

RECOMMENDATION: That you approve the permanent variance, subject to the following conditions:

- FermiForward implements the process outlined in the permanent variance application providing workers a place of employment that is as safe and healthful as would result from compliance with 10 CFR 851, Appendix A(4)(b), § 851.23(a)(3), § 851.27(d)(1), and § 851.27(d)(2), as required by Subsection (d)(2)(ii) of § 851.31, *Variance Process.*
- FermiForward informs affected workers not previously informed under the FRA permanent variance application process, of the variance. This must include providing a copy to their authorized representative, posting a statement, giving a summary of the application and specifying where a copy may be examined.
- FermiForward must inform affected workers not previously informed under the FRA permanent variance application process, of their right to petition the EHSS Director for a conference and provide details on how to request the conference.

APPROVE: GLR DISAPPROVE:_____ NEEDS DISCUSSION:_____ DATE:12/27/2024