U.S. Department of Energy
Washington, D.C.

ORDER

DOE O 420.2C

Approved: 7-21-2011

SUBJECT: SAFETY OF ACCELERATOR FACILITIES

1. PURPOSE. To define accelerators and to establish accelerator specific safety requirements and approval authorities which, when supplemented by other applicable safety and health requirements, promote safe operations to ensure protection of workers, the public, and the environment for Department of Energy (DOE) including National Nuclear Security Administration (NNSA) accelerators.

2. CANCELLATION. DOE O 420.2B, *Safety of Accelerator Facilities*. Cancellation of a directive does not, by itself, modify or otherwise affect any contractual or regulatory obligation to comply with the directive. Contractor Requirements Documents (CRDs) that have been incorporated into a contract remain in effect throughout the term of the contract unless and until the contract or regulatory commitment is modified to either eliminate requirements that are no longer applicable or substitute a new set of requirements.

3. APPLICABILITY.

   a. Departmental Applicability. Except for the equivalencies/exemptions in paragraph 3.c, this Order applies to any DOE Organization with programs involving accelerators and accelerator facilities or modules thereof and their operations. The Administrator of the NNSA assures that NNSA employees comply with their responsibilities under this directive. Nothing in this directive may be construed to interfere with the NNSA Administrator's authority under section 3212(d) of Public Law (P.L.) 106-65 to establish Administration-specific policies, unless disapproved by the Secretary.

   b. DOE Contractors.

      (1) Except for the equivalencies/exemptions in paragraph 3.c, the CRD (Attachment 1) sets forth requirements of this Order that apply to contractors whose contracts include the CRD.

      (2) The CRD must be included in site/facility management contracts that involve the management and operation of accelerators and accelerator facilities or modules thereof unless superseded by an alternative standard.

   c. Exemptions/Equivalencies for DOE O 420.2C. Accelerators and accelerator facilities or modules thereof that meet at least one of the criteria in paragraph 3.c.(1) or as specifically provided in 3.c.(2) are exempt from the requirements in paragraph 4 of this Order. The DOE Program Secretarial Officer (PSO) or NNSA Administrator may approve alternate safety standards, requirements or DOE Directives that provide equivalent or greater protection to ensure safety as stated in paragraph 3.c.(3) in accordance with the provisions of paragraph 5.

(1) Exemption. DOE facilities whose hazards can be safely managed under the provisions of Title 10, Code of Federal Regulations (CFR), Part 835 and Part 851 that are non-complex in nature and that produce only local work area impacts. Examples of such facilities include:

(a) Radiation or current generating devices;

(b) A room-sized accelerator with a single external/extractable beam, an active safety system, and a single point of entry into the room;

(c) X-ray generators (below 10 MeV) or neutron generators (accelerating potential below 600 keV) that are bench top in size and that have a single external/extractable beam and a single operator such as those that are operated in accordance with American National Standards Institute (ANSI) N43.3-2008, or National Council on Radiation Protection and Measurements (NCRP) Report 72-1983 or other applicable Program consensus standard; and

(d) Unmodified commercially available equipment including, but not limited to, electron microscopes, ion implant devices, and x-ray generators.

(2) Exemption. DOE may approve other accelerator exemptions, in addition to those examples listed in paragraph 3.c.(1), from the requirements of this Order in accordance with the provisions of paragraph 5 of this Order.

(3) Equivalency. The DOE PSO/NNSA Administrator may specify alternate safety standards, requirements or DOE Directives that provide equivalent (or greater) protection in lieu of or in addition to the requirements of this Order. These alternate standards would be primarily for those accelerator facilities or modules thereof and their operations when they contain, use or produce fissionable materials in amounts sufficient to create the potential for criticality based on the configuration of the materials.

4. REQUIREMENTS.

a. DOE organizations are required to have oversight, consistent with current DOE oversight policy, over contractors who design, build and operate accelerators and accelerator facilities or modules thereof in order to be consistent with the DOE mission and operational objectives and comply with accelerator safety program provisions as described in the CRD. This includes oversight of any modifications to the facility, its equipment or program elements that have the potential to significantly impact the risk, complexity, visibility, safety and security of operating or maintaining the accelerator facility.

b. The following elements must be included in accelerator safety programs:

(1) an approved accelerator safety envelope (ASE);

(2) a safety assessment document (SAD);

(3) clearly defined roles and responsibilities for accelerator activities including those for training and procedures;

(4) an unreviewed safety issue (USI) process. A USI process supports configuration management efforts that helps ensure the facility and supporting safety documentation are maintained current and periodically updated;

(5) an accelerator readiness review (ARR) program that ensures facilities are adequately prepared for safe commissioning and/or operations; and

(6) a current listing/inventory of accelerators under this Order and exemptions or equivalencies granted in accordance with paragraph 3.c.(2) and 3.c.(3) of this Order.

c. DOE organizations must ensure accelerator facilities or modules that implement and operate to alternate safety standards, requirements or DOE Directives adequately address hazards in accordance with paragraph 3.c.(3) of this Order.

d. DOE organizations must ensure the Contractor Assurance System includes processes for the review of contractor accelerator safety program elements as specified in the CRD.

5. RESPONSIBILITIES.

a. DOE Program Secretarial Officer (PSO)/NNSA Administrator.

(1) Oversee the safe operation of accelerator facilities through the implementation of this Order, unless otherwise specified in this Order.

(2) Approve the Accelerator Safety Envelope for accelerator facilities where site boundary consequences for credible postulated accident scenarios potentially exceed 1 rem (0.01Sv) and/or Emergency Response Planning Guide ERPG-2.

(3) Approve Field Element Manager recommendations that require alternate safety standards, requirements or DOE Directives as they are applied to accelerator facilities in accordance with paragraph 3.c.(3) and ensure the appropriate DOE and ANSI standards are adequate to address the hazard.

(4) Grant equivalencies or exemptions from the requirements of this Order, as requested by the Field Element Managers.

b. DOE Field Element Managers.

(1) Ensure the safe operation of accelerator facilities through the implementation of this Order.

(2) Notify contracting officers of those contracts to which the CRD is applicable.

(3) Recommend to the PSO/NNSA Administrator any alternate safety standards, requirements or DOE Directives that are contractually-binding to the accelerator facility that are necessary to address the facility hazards in accordance with paragraph 3.c.(3).

(4) Approve the following except as provided in paragraph 5.a.(2):

(a) Accelerator Safety Envelope (ASE);

(b) Start of commissioning activities after ensuring that an appropriate Accelerator Readiness Review (ARR) has been conducted;

(c) Start of routine operations;

(d) Restart of an accelerator facility or activity after a DOE-mandated shutdown because of an USI or ASE violation;

(e) Activities that justify a USI;

(f) Decommissioning activities; and

(g) Exemption/Equivalency request in accordance with paragraphs 3.c.(2) and 3.c.(3).

(5) Notify the contractor of any approved or denied requests for exemptions or equivalencies.

c. Cognizant Contracting Officer.

Upon notification of applicability, the contracting officer is responsible for incorporating the CRD and any alternate safety standards, requirements or DOE Directives made applicable pursuant to paragraph 3.c.(3) into the contracts of affected contractors.

6. REFERENCES.

a. 10 CFR 835, Title 10, Code of Federal Regulations, Part 835 entitled Occupational Radiation Protection (10 C.F.R. Part 835).

b. 10 CFR 851, Title 10, Code of Federal Regulations, Part 851 entitled Worker Safety and Health Program (10 C.F.R. Part 851).

c. DOE G 420.2-1, Accelerator Facility Safety Implementation Guide for DOE O 420.2B, Safety of Accelerator Facilities.

d. National Council on Radiation Protection and Measurements (NCRP) Report 72-1983, Radiation Protection and Measurements for Low-Voltage Neutron Generators.

e. American National Standards Institute (ANSI) N43.3-2008, For General Radiation Safety Standard Installations Using Non-Medical X-Ray and Sealed Gamma-Ray Sources, Energies Up to 10 MeV.

7. DEFINITIONS. See Attachment 2

8. CONTACT. Questions concerning this Order should be addressed to the Office of Science Safety Security and Infrastructure at 301-903-9641.

BY ORDER OF THE SECRETARY OF ENERGY:

DANIEL B. PONEMAN
Deputy Secretary

CONTRACTOR REQUIREMENTS DOCUMENT (CRD)
DOE O 420.2C, *SAFETY OF ACCELERATOR FACILITIES*

Regardless of who performs the work, the contractor is responsible for complying with the requirements of this Contractor Requirements Document (CRD). The contractor is responsible for flowing down the requirements of this CRD to subcontractors at any tier to the extent necessary to ensure the contractor's compliance with the requirements and the safe performance of work. When the contractor conducts activities or provides items or services that affect or may affect the safety or health of workers or the public, or may affect the environment it must conduct work in accordance with the requirements contained within this CRD.

In addition to the requirements set forth in this CRD, contractors are responsible for complying with Attachment 2 to DOE O 420.2C referenced in and made a part of this CRD and which provide program information applicable to contracts in which this CRD is inserted.

The following program elements are to be complied with by the contractor organization prior to routine operation, as applicable, and must be included in an accelerator safety program:

- an approved accelerator safety envelope (ASE);
- a safety assessment document (SAD);
- clearly defined roles and responsibilities for accelerator activities including those for training and procedures;
- an unreviewed safety issue (USI) process. A USI process supports configuration management efforts that helps to ensure facility and supporting safety documentation are current and periodically updated;
- an accelerator readiness review (ARR) program that ensures facilities are adequately prepared for safe commissioning and/or operations; and
- a current listing/inventory of accelerators under this Order and exemptions or equivalencies granted in accordance with paragraphs 3.c.(2) and 3.c.(3) of this Order.

The contractor must request and obtain the necessary DOE approvals for exempted or equivalent accelerators, facilities or modules thereof, which will be processed by DOE as specified in paragraphs 3.c.(2), 3.c.(3) and 5 of this Order.

1. ACCELERATOR SAFETY ENVELOPE (ASE).

   a. A documented ASE must define the physical and administrative bounding conditions and controls for safe operations based on the safety analysis documented in the SAD.

   b. The ASE must be submitted to DOE for approval and may be submitted as a separate document from the SAD.

c. An activity expected to exceed the bounding conditions of the ASE requires DOE approval. Any activity violating the ASE must be terminated immediately and be put in a safe and stable configuration. Any activity that was shut down by DOE must not recommence until DOE approves the activity.

2. SAFETY ASSESSMENT DOCUMENT (SAD). A SAD represents the technical basis for the ASE, is maintained current and must:

a. identify hazards and associated onsite and offsite impacts to workers, the public, and the environment from the facility for both normal operations and credible accidents;

b. contain sufficient descriptive information and analytical results pertaining to specific hazards and risks identified during the safety analysis process to provide an understanding of risks presented by the proposed operations;

c. provide detailed descriptions of engineered controls (e.g., interlocks and physical barriers) and administrative measures (e.g., training) taken to eliminate, control, or mitigate hazards from operation; and

d. include or reference a description of facility function, location, and management organization in addition to details of major facility components and their operation.

3. UNREVIEWED SAFETY ISSUES (USIs). The USI process allows for the evaluation of accelerator activities that have the potential to significantly impact safety. Activities must not be performed if significant safety consequences could result from either an accident or a malfunction of equipment that is important to safety and for which a hazard analysis has not been performed. Activities involving identified unreviewed safety issues must not commence before DOE has provided written approval. The process for identifying USIs is considered to be an important component of configuration management.

4. ACCELERATOR READINESS REVIEWS (ARRs). ARRs must be performed before DOE approval for commissioning and routine operation and as directed by the DOE Program Secretarial Officer/NNSA Deputy Administrator or a DOE Field Element Manager. As part of the ARR process, the contractor must demonstrate to the satisfaction of the Field Element Manager that the following processes are in place:

a. A Contractor Assurance System that maintains an internal assessment process;

b. A Facility Configuration Management Program that is related to accelerator safety; and

c. Credited controls and appropriate administrative processes related to accelerator safety (e.g. training, procedures, etc.).

DEFINITIONS

This Attachment provides information associated with DOE O 420.2C as well as information applicable to contracts in which the associated CRD (Attachment 1 to DOE O 420.2C) is inserted.

1. **Accelerator**: a device employing electrostatic or electromagnetic fields to impart kinetic energy to molecular, atomic or sub-atomic particles and capable of creating a radiological area.

2. **Accelerator Facility**: the accelerator and associated roads within site boundaries, plant and equipment utilizing, or supporting the production of, accelerated particle beams and the radioactive material created by those beams to which access is controlled to protect the safety and health of workers, the public or the environment. The term facilities includes injectors, targets, beam dumps, detectors, experimental halls, non-contiguous support and analysis facilities, experimental enclosures and experimental apparatus utilizing the accelerator, etc, regardless of where that apparatus may have been designed, fabricated, or constructed, including all systems, components and activities that are addressed in the Safety Analysis.

3. **Accelerator Operations**: those activities of an accelerator and any associated accelerator facilities that are bounded by the Safety Assessment Document. Accelerator operations (and post operations) include the production, dispensing, analysis, movement, processing, handling and other uses, and storage of radioactive material within the accelerator facility.

4. **Accelerator Readiness Review (ARR)**: an ARR is a structured method for verifying that hardware, personnel, and procedures associated with commissioning or routine operations are ready to permit the activity to be undertaken safely.

5. **Accelerator Safety Envelope (ASE)**: a set of verifiable physical and administrative credited controls that define the bounding conditions for safe operation and address the accelerator facility hazards and risks.

6. **Commissioning**: a phase of an accelerator facility operation that is typically used to conduct beam testing and to verify specifications in a new or designed functional mode. Commissioning periods may be tailored to the needs of each facility and there may be great variations in their duration, breadth, and formality, but in all cases the activities will be bounded by an ASE and preceded by an ARR. At its conclusion, the accelerator is ready for performance of an ARR for routine operations, or directly for routine operations if the ARRs were part of the commissioning process.

7. **Credited controls:** controls determined through safety analysis to be essential for safe operation directly related to the protection of personnel or the environment.

8. **Criticality**: the condition in which a nuclear chain reaction becomes self-sustaining without the use of external beams of ionizing radiation from an accelerator.

9. **Safety Analysis**: a documented process to systematically identify the hazards of a given operation; including a description and analyses of the adequacy of measures taken to eliminate, control, or mitigate the hazards and risks of normal operation; and identification and analyses of potential accidents and their associated risks.

10. **Safety Assessment Document (SAD)**: a document containing the results of a safety analysis for an accelerator facility pertinent to understanding the risks of operating the accelerator facility.

11. **Unreviewed Safety Issue (USI)**: a significant increase in the probability of or consequences from (1) a planned modification that creates a previously unanalyzed postulated accident or condition that could result in a significant adverse impact or (2) a previously analyzed postulated accident or condition.