

The Evolution of Accelerator Regulation

DOE Accelerator Safety Workshop

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<u>Outline</u>

- Origin
- Transition from Nuclear Safety
- Developing an Accelerator Specific Order
- Lessons Learned, Feedback, and Continuous Improvement
- Implementation Guide
- Summary
- Acknowledgments



Origin and Early History

- DOE Accelerator facilities were previously regulated under portions of Nuclear Safety Orders.
- In 1979, DOE Order 5481.1, *Safety Analysis and Review System*, required safety analyses of DOE operations to identify hazards, hazard controls, an assessment of risk, and management authorization.
- In 1980, DOE Order 5480.1, *Environmental Protection, Safety, and Health Protection Program for DOE Operations*, provided requirements for the *Safety of Nonreactor Nuclear Facilities* in Chapter V and for the *Safety of DOE Owned*-*Reactors* in Chapter VI.
- At that time, DOE Accelerator facilities were subject to the requirements of DOE Order 5480.1 except for Chapters V and VI.



DOE Order 5480.5

- In 1986, Chapters V and VI of DOE Order 5480.1 were replaced by DOE Order 5480.5, *Safety of Nuclear Facilities*, and DOE Order 5480.6, *Safety of DOE-Owned Nuclear Reactors*, respectively. DOE Order 5480.5, 5480.6, and 5480.1B were superseded by DOE Order 5480.23, *Nuclear Safety Analysis Reports* in 1992.
- Tiger Team reviews in 1990 and 1991 of National Laboratories identified gaps and inconsistency in regulation of accelerators.
- In 1991, a DOE/Contractor workshop was held; at the Workshop, the SLAC accelerator guide, originally developed for SLAC operations, was used as a starting point for formulating an accelerator-specific order.



<u>DOE O 5480.25</u>

- DOE Order 5480.25 *Safety of Accelerator Facilities* issued in 1992.
- Focused on principles and core functions of an effective accelerator safety program.
- Only included requirements that contributed to accelerator safety and were not addressed in other DOE Orders.
- Provided a definition for accelerator and accelerator facility.
- Required processes to provide protection equal to those applicable to nuclear facilities. These include:
 - ARRs (independent verification of physical and administrative controls)
 - SADs (documenting the hazards, controls, and risks of the facility)
 - USIs (documenting modifications, or an event that had not been evaluated)
- The USI was to be used to maintain the SAD "up-to-date" without rewrites for each modification.



Additional Features of DOE O 5480.25

- Applicable to DOE Elements involved with the operation of accelerators.
- Recommended the use of a graded approach.
- Research activities, such as "test stands" did not require approvals or exemptions.
- Excluded commercial accelerators with built-in protective features.
- DOE Headquarters and Field Managers were required to approve an Accelerator Safety Envelope that bounds the activities and provides reasonable assurance that the risk was acceptable.
- The responsible DOE official had the inherent right to impose more stringent approval levels than called for within the Order.



5480.25 Became 420.2 in 1998

- A new designation emerged in the directive reordering program
- 420.2 requirements were taken directly from 5480.25 except for the following changes;
 - a. Three additional exclusions
 - i. Non-medical X-ray devices,
 - ii. Low-voltage neutron generators, and
 - iii. DOE Facilities where 5480.23 was already applied
 - b. Eliminated the requirement for hazard classification of accelerator facilities



Evolution of 420.2

- In 2001, 420.2 was cancelled, and 420.2A was issued • Extended the Order to all NNSA owned or leased accelerators.
- Order renewed in 2004, became 420.2B on 7-23-2004

 Applicability was expanded to "accelerator facilities (accelerators and their operations) or modules thereof, including injectors, targets, beam dumps, detectors, experiments, experimental halls, etc."

• 420.2C was issued on 7-21-2011

 Clarify roles and responsibilities and focus the Order on specific requirements for accelerators.

• 420.2C is currently under revision

 Refine applicability and definitions, address regulatory gaps, clarify exemptions and approval authorities, identify requirements for modifications and reclassifications.



DOE Guide 420.2-1

- DOE, NNSA, and Contractor personnel developed an Implementation Guide for DOE O 420.2B to incorporated lessons learned from a decade of safe operating experience accumulated since DOE Order 5480.25 was issued.
- Address the various stages of accelerator operations from design to decommissioning, and a variety of new technical topics including electrical safety.
- Described non-mandatory, best-management approaches to support implementation of requirements in DOE O 420.2B.
- DOE Guide 420.2-1 Accelerator Facility Safety Implementation Guide for DOE O 420.2B, Safety of Accelerator Facilities issued on 7-1-2005.



Additional Features of DOE G 420.2-1

- Updated to 420.2-1A on 8-1-2014 to support O 420.2C.
- Developed to establish a standard of design and operation that effectively addresses the unique attributes of particle accelerators.
- Utilizes a tailored approach based on the complexity of the accelerator.
- Does not duplicate other Guides or Consensus Standards.
- Additional focus on safety of operations.
- Has served as an effective informational tool for the accelerator community.
- Order establishes "what" is required by DOE.
- Guide allows contractors to select "how" best to achieve the required outcome.



<u>Summary</u>

- DOE Regulation of Accelerators has evolved over the last 40 years.
- As accelerators have advanced, becoming more complex and powerful, the DOE regulatory requirements have accommodated the hazards.
- A unique arrangement has existed between DOE and the accelerator community, involving experts in the development of regulatory requirements, and shared expertise between facilities.
- Continued involvement by all parts is a requirement for safe, effective, and efficient operations.
- The partnership between DOE and the accelerator community will continue to provide a platform for the evolution of the Accelerator Safety Order and Implementation Guide.



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