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BACKGROUND  
[BASES AND RATIONALE]  
FOR  
DOE 5480.25, SAFETY OF ACCELERATOR FACILITIES

This document provides the bases and rationale for the content of Order DOE 5480.25. Some subparagraphs of the Order are not specifically commented upon because their genesis was felt to be evident.

INTRODUCTION TO THE BACKGROUND

Accelerators have been in use as research tools for decades, predating the advent of the atomic energy program in the mid-1940s and the regulation and commercial use of nuclear facilities and materials authorized by the Atomic Energy Act of 1954 (The Act). Accelerators are distinctly different from the nuclear facilities regulated under The Act. In fact, accelerators are not included in the definitions of facilities and radioactive materials that are regulated under The Act. Only source, special nuclear and byproduct materials are regulated under The Act. DOE 5480.25 is intended to stipulate requirements specific to accelerator facilities that will provide a level of safety appropriate for those facilities.

To aid in providing for the distinct treatment of accelerators, different terminology has been employed in the Order for certain concepts that are currently applied solely to nuclear facilities. This was felt to be necessary because, in each case, while the concepts embodied in the nuclear terms had value for an accelerator safety program, the specifics of their application to accelerators were sufficiently different, and it was felt best to avoid any potential misapplication of the detailed implementing requirements developed for nuclear facilities that could result from using identical terms. In addition, because of the greater prescriptiveness of the requirements associated with these concepts as they are being applied to nuclear facilities, this deliberate decoupling facilitates the application of a graded approach with cost-benefit evaluations to achieve the desired level of safety for accelerators. Those nuclear concepts are: "safety analysis report", "technical safety requirements", "operational readiness review" and "unreviewed safety question".

In developing the Order, a "value added" test was applied to prospective requirements. A requirement was included only when it contributed something for the safety of accelerator facilities that was not already required by some other Order. It was not necessary for a requirement to be new, only that it provide a perspective that was specific to accelerator facilities. This could take the form of amplifying or supplementing requirements existing in other Orders.

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## 1. PURPOSE.

In establishing safety program requirements specific to accelerator facilities, the Order does not attempt to incorporate, even by reference, the entire body of ES&H requirements already imposed on DOE-controlled operations. NEPA, fire protection and industrial hygiene requirements, to select a few examples, apply to accelerator facilities. The applicability of other ES&H Orders to accelerator facilities is established by those individual Orders either through an "Application" section or the definitions of key terms.

Paragraph 1a reflects the intent to provide for a level of safety and health protection comparable to that required of nuclear facilities by DOE 5480.5 and DOE 5480.20, which exclude accelerators from their coverage. Comparability is achieved by focusing on the key elements and principles of a safety and health program appropriate for accelerator facilities.

Paragraph 1b reflects the objective of the Order to place specific emphasis on how certain requirements and concepts in existing ES&H Orders should be applied at accelerator facilities. By implementing those requirements in this Order, the contractor will also be meeting the intent of the companion requirements in other Orders. As an example of this, paragraphs 10 and 11 of the Order elaborate on how the requirements of DOE 5481.1B, SAFETY ANALYSIS AND REVIEW SYSTEM, regarding safety analysis and the acceptance of risk, are to be applied to accelerator facilities.

## 2. SCOPE.

This section and the next one addressing the application of the Order to contractors were originally combined. For procurement-related purposes, the original section was separated into two sections: a Scope section dealing only with the Order's applicability to organizational elements within DOE, and a new section dealing with its applicability to contractors.

The developers of the Order tried several approaches to describing the universe of accelerators to which it made sense to apply the Order. One approach considered was to make the Order applicable to all DOE program organizations and all contractors responsible for the operation of accelerators that were Government-owned and contractor-operated whether the site was Government-owned or Government-leased. While this appeared to be clear enough to define an appropriate set of facilities, it presented some problems to those having a procurement perspective. Consequently, two other approaches were considered. The accelerators to which this Order was to apply could be specified either in terms of whether the contract for operation was a management and operating (M&O) contract, or whether the contract for operation contained either of two safety contract clauses: the standard Safety and Health contract clause (DEAR 970.5402-2), or the Radiation Protection and Nuclear Criticality contract clause (DEAR 952.233-72). The latter approach was selected, because it was the more precise of the two, less subject to misinterpretation, and contractually enforceable. That approach is reflected in paragraph 3 of the Order.

### 3. APPLICATION TO CONTRACTS.

The wording of this section is largely that proposed by the Office of Procurement, Assistance, and Program Management (PR). While some of the wording may appear unusual to those who are technically oriented, it has a firm basis derived from legal and procurement history. A prime example is the phrase "or should contain", which is there because of legal rulings that have concluded that failure to impose appropriate safety and health clauses in a contract does not relieve the Government of its responsibility to assure safety and health.

### 4. EXCLUSIONS.

This section narrows down the universe of accelerator facilities for which DOE has responsibility in one form or another to those for which increased formality and attention to safety are needed to provide assurance that mishaps with unacceptable environmental, safety, and health implications will be avoided.

Paragraph 4a excludes those commercial packaged devices, which come with their own built-in protective features. Experience has shown these protective features provide adequate protection to workers and the environment for their intended applications. The adjective "unmodified" and the phrase "acceptable for industrial applications" are both intended to require that the devices be used as intended according to the operating manufacturer's instructions and design (i.e., without significant custom modifications by the manufacturer or the contractor).

Paragraph 4b establishes that the requirements of this Order need not be applied to accelerator facilities whose inherent characteristics are such that it is not necessary to establish an entry control program for access to the immediate environs of the accelerator and/or experimental areas for radiological safety reasons. Employing the concept of a "radiological area" (see the discussion of this term in Section 6 of this document) provides a de minimis level of concern for potential radiological impacts that also was felt to represent a class of accelerators for which the non-radiological hazards also would be expected to be relatively benign or routinely accepted. The traditional occupational hazards, including high voltage, would still be present, but those are already adequately covered by other DOE Orders. This notwithstanding, where concerns for the non-radiological hazards are high, the process for hazard classification of the accelerator facility, required by paragraph 8b of the Order, will lead to the decision that the facility should come under the Order. In addition, the program office can always require any accelerator facility that might otherwise be excluded, to abide by the Order, fully or in part.

From the definition of an accelerator used by DOE 5480.25, the applicability of the Order to fusion devices is not absolutely clear. While the drafters of the Order did not intend that fusion devices be covered, a specific exclusion was not provided. It was felt that the contractors operating these devices could make the case for their exclusion if challenged.

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## 5. REFERENCES.

Early drafts of the Order attempted to list all ES&H Orders applicable to accelerators, whether or not they were specifically mentioned in the Order. It was soon realized that this was futile because of many current changes underway or planned for these Orders. The references likely would be inaccurate almost as soon as the Order was issued. The approach used was to include as references only those Orders which were specifically mentioned in the Order. In any case, as paragraph 8a of the Order states, all non-nuclear ES&H Orders (of which DOE 5480.7A, FIRE PROTECTION, of 2-17-93, and DOE 5480.10, CONTRACTOR INDUSTRIAL HYGIENE PROGRAM, of 6-26-85, are typical) apply to accelerator facilities whether specifically referenced in this Order or not.

A number of reviewers of drafts of the Order suggested that the Order should mention and reference ANSI N43.1-1978, "Radiological Safety in the Design and Operation of Particle Accelerators" and SLAC-327, "Health Physics Manual of Good Practices". The former document has been withdrawn by ANSI because it has missed two mandatory review deadlines, but is still listed in DOE 5480.4, ENVIRONMENTAL PROTECTION, SAFETY, AND HEALTH PROTECTION STANDARDS, of 5-15-84, as a mandatory standard for DOE operations. Both documents are "suggested for consideration" in accelerator operations by the Radcon Manual (Part 6 of Chapter 3 of that document). Since the applicability of these documents for accelerator facilities has been addressed sufficiently by DOE 5480.4 and the Radcon Manual, they have not been mentioned or referenced in the Order. This is consistent with the approach to inclusion of references in the Order that was described in the preceding paragraph.

Reference to the Radcon Manual has been integrated into the reference to DOE 5480.11 because of the intimate relationship of the two.

## 6. DEFINITIONS.

As discussed in the Introduction, the Order has employed several new terms for concepts that are well-established only for nuclear facilities. Those nuclear facility-related concepts are embodied in "operational readiness review", "safety analysis report", "technical safety requirements" and "unreviewed safety question". The comparable terms in this Order are accelerator readiness review, safety assessment document, safety envelope and unreviewed safety question, respectively. The distinctive difference between these terms for accelerator facilities compared to their nuclear facility counterpart is given below. If and when these concepts are developed in ES&H Orders for activities other than nuclear facilities, this Order can be brought into conformance with the applicable terminology.

Three approaches were considered for identifying the devices that were to be covered by this Order. One was to define an accelerator from a fundamental physics perspective, and use an Applications section to identify those accelerators to which the Order either did or did not apply. Another approach considered was to define an accelerator in such a way that it included only devices to which the Order applied. (For example, x-ray generators could be

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defined as being included only if they had an accelerating potential of more than 1 MeV.) The third approach was to provide an attachment to the Order containing a list of the accelerators covered. The first approach was chosen, albeit with one concession to the second approach, because this permits the most straightforward and recognizable definition. One qualification, "capable of creating a radiological area", has been added to the definition to screen out devices such as fluorescent lights and cathode ray tubes that a purist could argue would need to be justified for exclusion from coverage.

Accelerator facility has a very specific meaning for the purposes of this Order. It is more than just the high-vacuum components used to accelerate, store, and collide the particle beam; the tunnels and other structures in which they are housed; and the shielding. It also includes any utilization of the beam in experimental areas and enclosures, even when they are remote from the beam. It is not intended, however, to include office and support spaces, even when these may be under the same roof as the accelerator. The test for what physical space should be included as part of the "facility" is whether access needs to be controlled to protect the health and safety of persons. The term "persons" was carefully selected to avoid giving the impression that only the control of occupational workers was being addressed. Members of the public, official visitors, etc. are also intended to be included. The motivation for narrowing down the applicable space was to make the requirements apply only to areas where they have meaning. For example, the training required by paragraph 12 of the Order need not be required of everyone, but rather only those who would enter areas that were controlled. Persons outside these controlled areas are subjected to no unique risks due to accelerator operation or utilization. In particular, no emergency actions are required of these "casuals" under any realizable circumstances, except for those circumstances that might be encountered in any building (e.g. fires).

Concerning the inclusion of experimental apparatus "regardless of where that apparatus may have been designed, fabricated, or constructed" in the scope of an accelerator facility, it was intended that apparatus designed, fabricated, or constructed outside the jurisdiction of the Department's safety requirements not be exempted from the requirements of DOE 5480.25 upon being installed in the facility. In particular, the safety standards established by the contractor for experimental apparatus per paragraph 10f, are to be applied to such apparatus.

An accelerator readiness review is the counterpart of an "operational readiness review" (ORR) for a nuclear facility. It differs from an ORR most significantly in when it makes sense to require that one be done. What is to be done is very similar. The ORR term being proposed in the draft versions of the revised nuclear directives in existence when the accelerator order was being drafted were specifying as part of the definition for an ORR the specific circumstances under which an ORR would be required. As part of its definition, an ORR was to be performed prior to authorizing construction of a new facility, prior to authorizing initial operation at a new facility, and prior to authorizing resumption of activities after an Unreviewed Safety Question (USQ) had arisen. This was not appropriate for accelerator facilities, where safety considerations dictate the need for a readiness review prior to authorizing commissioning (the equivalent of prior to initial

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operation at a nuclear facility), prior to authorizing routine operation, and prior to resumption of an activity stopped by DOE for environmental, safety, or health reasons. The only pre-construction safety review that has importance for accelerator facilities is a review of the provisions being made in the design for worker health and safety. This review is required by paragraph 9e of the Order. It would not be a productive use of time and resources to perform another safety review or a pre-construction ORR for an accelerator facility. This incompatibility (prior to authorizing routine operation for an accelerator vs. prior to construction authorization for nuclear facilities) resulted in the Order establishing a different term.

The term accelerator safety envelope was used in the draft versions of the Order without the qualifying word "accelerator", but there was some concern expressed during the final concurrence process that the term "safety envelope" was also being used in other contexts unrelated to accelerators. To avoid any possible misinterpretations, it was decided to employ a fully qualified term in the Order.

Accelerator Safety Envelope is the accelerator facility counterpart of "technical safety requirements" for nuclear facilities. The Accelerator Safety Envelope is less structured than its counterpart while still embracing the concept that the constraints required to ensure safe operation must be specified, and DOE must agree with the operating contractor that they are appropriate and sufficient. The Accelerator Safety Envelope consists of both a set of physical conditions and a set of administrative conditions covering the accelerator and the experimental activities. On the other hand, technical safety requirements have four categories of requirements: operating limits, surveillance requirements, administrative controls, and use and application. They also require two appendices: one providing the bases for operating limits and associated surveillance requirements, and the other describing passive design features which, if modified, would have a significant effect on safe operation. The operating limits, themselves, are a well-constructed set of safety conditions that provide what amounts to three layers of safety protection: safety limits, limiting control settings, and limiting conditions for operation (in order of decreasing safety concern). Because the consequences of incidents at an accelerator facility are considerably less than for most nuclear facilities, this added complexity would only contribute marginally at best to the safety of accelerator facility operations. Consequently, the Order has used a different term, Accelerator Safety Envelope, for the set of requirements more appropriate to bound accelerator facility operations.

The distinction made in the Order between approving and authorizing was done to be consistent with the way the terms are used in other DOE safety Orders. In general terms, the DOE Contracting Officer (a DOE Operations Office Manager or his/her representative) **authorizes** actions to be taken by a contractor. On the other hand, the actions required of DOE Headquarters program officials by SEN-6 and other notices in that series are **approvals** issued prior to authorization. The hierarchy set up by the Order requires the DOE Contracting Officer to receive specified approvals from senior program officials prior to authorizing the contractor to undertake those specific activities identified by the Order.

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Commissioning is the term used in the Order to refer to the process of determining the performance characteristics of an accelerator and for the safety performance characteristics of experimental setups. The definition specifies when commissioning is to be considered as commencing, namely with the first introduction of a particle beam into the system. The rather nebulous term system was selected rather than component to permit the "test-stand" checkout of magnets and other equipment without the need for safety-related approvals or exemptions. Commissioning is completed before the accelerator is placed into routine service, or, in the case of experimental setups, before data collection commences. It is specifically addressed in the Order because this phase is the period of greatest safety uncertainty at accelerator facilities, even though the initial particle beam currents are kept low to minimize possible errant beam damage and radiation exposures. During commissioning, the engineered safety features designed into the facility and the administrative controls, which usually have been adapted from other facilities, are tested during this first introduction of a particle beam into the system to ensure their adequacy for the specific activity.

The distinction between hazard and risk is often blurred in casual usage, and since these terms are both used in the Order, they are both defined. The definition of "risk" used is that of DOE 5481.1B, SAFETY ANALYSIS AND REVIEW SYSTEM, with the substitution of "harm" for several other words used in that definition. This substitution has improved the comprehension of the definition. The definition of hazard being used is the same as the one proposed in Order DOE 5480.23, NUCLEAR SAFETY ANALYSIS REPORTS, of 4-10-92, with two exceptions. Where the DOE 5480.23 definition uses the phrase "credibility of accident scenarios", this Order uses "likelihood of a harmful event occurring" to tie it more directly to the definition of risk, and the accelerator Order's definition has added a second sentence identifying the hazards categories specified in DOE 5481.1B. If and when the hazard categories are changed, it is the intent to modify the definition accordingly by issuing an Order Page Change. Also, it is the intent that the hazard classification system employed by accelerator facilities be the same as that used by the non-nuclear facilities. The concept of hazard is employed in the Order because the nature and magnitude of the hazards presented by an accelerator facility are being used to determine the levels of DOE management involvement in the safety-related decisions that are to be made. The greater the hazards, the more important the technical and administrative measures become that are proposed to control the hazards and to mitigate their consequences. The adequacy of these measures determines the residual risks that those hazards will present to people and the environment. The DOE program organization is required by the Order to make a determination for the Department that the risks are acceptable.

The definition of Radiological Area originally was a direct lift of the definition of that term from DOE 5480.11. It read:

"Radiological Area (as defined in DOE 5480.11) means any area within a controlled area where an individual can receive a dose equivalent greater than 5 mrem (50 microsieverts) in 1 hour at 30 cm from the radiation source or any surface through which the radiation penetrates, or where airborne radioactive concentrations greater than

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1/10 of the derived air concentrations are present (or are likely to be), or where surface contamination levels greater than those specified in Attachment 2 of DOE 5480.11 are present."

EH commented in its concurrence memo that the recently issued Radiological Control (Radcon) Manual makes the definition of "radiological area" in 5480.11 no longer an operable term. The definition now used in DOE 5480.25 employs the terminology in the Radcon Manual's Chapter 2, Part 3, to specify the applicable conditions.

Routine Operation has been identified in the Order as a condition that presents its own set of safety considerations. The adequacy of the proposed Accelerator Safety Envelope based on the results of commissioning is one consideration. Maintaining control over the configuration of the design and operational safety features, and avoiding laxity are two other considerations that need to be addressed. The Order calls for formally determining that appropriate reviews and precautions have been taken before such operation commences. The definition does not specify a precise milestone which would signify when commissioning of an accelerator ceases and routine operation starts. The intent is that this should be negotiated by DOE and the contractor in each instance. In selecting the term "routine" operation, it was recognized that the term was imperfect in that accelerator operations and experimental activities are widely variable and anything but routine in the sense that the same parameters may not pertain for any extended period of time.

Safety analysis, as used in DOE 5480.25, is the same concept as defined in Order 5481.1B, with several minor changes to connect it more directly to accelerators and the terms used by DOE 5480.25.

Safety Assessment Document was chosen as the term to label the document which contains the results of a safety analysis for an accelerator facility (or any module thereof). The term "safety analysis report" (SAR) has been employed only in DOE orders addressing the safety of nuclear facilities, although it has been adopted by non-nuclear facilities in some instances and has tended to become a generic term for a documented safety analysis. However, with the growing prescriptiveness and detail in both the scope and content of safety analysis report requirements, as the concept is being applied to nuclear facilities, it was felt that a separate and distinct term was needed for the accelerator document. This avoids having inappropriate or unnecessary detail being imposed on the required documentation of the safety analysis for an accelerator facility solely because that specific term was used. Current requirements for Safety Analysis Reports allow the use of a graded approach in the level of analysis and documentation for each facility. However, SARs have a specified content, and deviations from it require prior written approval from the DOE Program Secretarial Officer. The content currently being espoused for a SAR is appropriate for accelerator facilities only in the most basic sense. While most topics have applicability to some degree, there likely would be as many deviations from the specified substance of the proposed topics as there would be inclusions. As an example, Attachment I of Order 5480.23 provides the content for each of the 21 topics. A typical element under "Initial Testing, In-service Surveillance, and Maintenance" in

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that Attachment reads "Safety Analyses should document a systematic demonstration of the ways the surveillance test program furnishes realistic validations of the performance of safety functions under accident conditions, and catalogs failure modes of safety equipment that could be detected in planned surveillance tests." While certain aspects of this have applicability to accelerators, full application would be excessive because of fundamental differences in the potential hazards. To justify addressing this element from a limited perspective could potentially take almost the same effort that a nuclear facility would require to address it fully. The contribution that this would make to real safety appears marginal. The approach taken by DOE 5480.25 for documenting the safety analysis is felt to be more cost effective in achieving a level of safety for accelerator facilities comparable to that for nuclear facilities.

The definition for an Unreviewed Safety Issue (USI) is a variation of the usage of the term "unreviewed safety question" (USQ) for nuclear facilities in DOE 5480.21, UNREVIEWED SAFETY QUESTIONS, of 12-24-91 (which does not explicitly define the term!). The accelerator Order had relied on the USQ definition in DOE 5480.1B until it was recognized that DOE 5480.21 had, in fact, canceled that definition for all facilities, not just for nuclear facilities. The principal differences between the DOE 5480.21 usage of the term USQ [see DOC 5480.21, paragraph 10c] and the definition of an USI used in the accelerator Order are:

1. The preservation of the concept of "significance" which was present in the DOE 5480.1B definition of USQ, but is missing from the DOE 5480.21 definition. Without this qualifier in the definition, contractors could potentially be unnecessarily burdened by having activities stopped until inconsequential issues are formally addressed.
2. Omission in the accelerator Order of "analytic inadequacy" as a separate element that could result in a USI being identified. Identifying an analytic inadequacy results in bringing into question whether the existing risk level of activities at the facility is significantly greater than had been analyzed and found acceptable. This obviously must be cleared up expeditiously, but for accelerators does not necessarily require that affected activities must cease until the inadequacy is rectified, as would be dictated by paragraph 8e of DOE 5480.25 if an analytic inadequacy were categorically required to be classified a USI. The precautions to be taken must be decided on a case-by-case basis, but it was felt that in most cases operating an accelerator facility until the analytic inadequacy was eliminated in a timely manner would be acceptable because the maximum adverse consequences of continuing to operate generally would not be serious.
3. The treatment of a "reduction in the margin of safety" at an accelerator facility as a subset of the more general condition of experiencing a "significant increase in the probability of occurrence of an undesirable event", rather than as a separate and distinct condition for determining the existence of a USI.

## 7. RESPONSIBILITIES AND AUTHORITIES

This section evolved to its present content based on numerous insightful comments on earlier versions of the Order. Earlier versions had actions required by the various parties specified in the various parts of the Order where specific safety topics were addressed. The general sense of the comments received was that the responsibilities of the various parties and the actions expected of them needed to be coherently summarized in this section rather than appearing only in one of the subsequent topical sections of the Order.

The Order assigns responsibilities and authorities at only two levels: headquarters and field. In each case only the senior-most program position is used. Early versions of the Order had also indicated responsibilities for program managers in HQ and Contracting Officers in the field, but it was found that variations in organizational structures and management philosophies made it impractical to designate responsibilities any further down in either organization. This treatment in no way implies that current HQ/FO/Contractor relationships should be changed; contractors would continue to relate to their Area (or Site) Offices as before.

No responsibilities were originally assigned in the Order to DOE's independent oversight organizations because their roles are adequately defined in other environmental protection, safety, and health protection Orders or SEN documents. Based on a concurrence comment by EH, general responsibilities have been assigned to EH in paragraphs 7a(6) and 7c of the Order using in large measure the wording provided by EH. Similarly, based on an informal comment by NS, general responsibilities for that organization were also assigned by the Order. [See paragraphs 7a(6), 7a(7), and 7d]. In neither instance were any responsibilities given to these organizations that were not already specified in other orders or by SEN documents.

There are no responsibilities assigned to contractors by the Order. The responsibilities and authorities paragraph of DOE Orders addresses only DOE organizational components.

The approval levels for risk acceptance specified in paragraphs 7a(3) and 7b(3) are generally higher than those proposed by DOE 5481.1B. This is necessary to make them consistent with the current DOE management policy, as expressed through the SEN-6 series.

While not explicitly highlighted in the Order, the acceptance of risk assigned to the PSOs and the operations office managers in paragraphs 7a(3) and 7b(3) requires, among other things, that they approve the safety envelope that bounds the activity and that provides reasonable assurance that the risk of performing the activity will remain acceptable.

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The use of the term "exemption" in paragraph 7a(6) was deliberately selected rather than "exception", or "variance", or some other term in order to parallel its usage in the umbrella ES&H Order, DOE 5480.1B, where "generic exemption" is defined. In general use, "exemption" is intended to be a temporary or permanent release from a requirement in DOE 5480.25. It was not explicitly defined in the Order only because of the misimpression that DOE 5480.1B had defined this exact term (whereas the term defined in DOE 5480.1A was "generic exemption").

A change was made to paragraph 7b(1) between the draft versions of the Order and the final version. The requirement to "evaluate contractor training plans to ensure their adequacy" has been changed to require monitoring of contractor training efforts. This change makes this paragraph more consistent with paragraph 12, "Personnel Training and Qualification Requirements", which does not require the contractor to prepare anything identified as "training plans".

The wording of paragraph 7b(4) did not intend to require that, if one part of an accelerator facility (say a specific experiment) is classified as high-hazard, the entire facility must take on the high-hazard classification. On the other hand, neither did it intend to permit approval to restart a high-hazard activity that could be located within an otherwise less than high-hazard facility at any level lower than the PSO. If the specific activity stopped by DOE because of an ES&H concern is an integral part of the operation of a high-hazard facility or has been separately classified as high-hazard, then PSO approval is intended to be required. It was not intended to require that an activity stopped by DOE that is not related to the high-hazard activity, be saddled with the rigor rightly required before approving restart of a high-hazard activity.

Paragraph 7b(7) assigns the responsibility for identifying specific documents that a given program organization may wish to have submitted to it for information when those documents are not otherwise explicitly required by the Order to be submitted. While the DOE program office always has the right to ask for the submission of any information it wishes, the inclusion of this item is intended to encourage the selective identification of such information, rather than having the Order peppered with "and submit to DOE for information" clauses that would result in the submission of information that not all program offices may wish to see except on an occasional, as-needed, basis.

Paragraph 7b(10) was added at the insistence of DOE's Office of Procurement, Assistance and Program Management (PR) for the stated purpose of identifying procurement responsibilities. ER was told that all recent directives are being required to insert similar wording to address the matter in question. ER staff had taken the position that PR's needs would be better met if the language were incorporated into one of its own directives so that the responsibility would be universally assigned. This viewpoint was expressed to PR. Until such time as that occurs, which PR claims is in process, DOE 5480.25 will need to have this paragraph. The wording serves to alert potential bidders to the requirements they will be expected to meet. The fine-structure of the wording leads to the immediate reaction that since all

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requirements of the Order are applicable, this statement is not required. In reality, this is not the case. For instance, any organization with the "Radiation Protection and Nuclear Criticality" clause in its contract with DOE will not be required to meet those requirements of DOE 5480.25 that address occupational safety and health, because DOE has elected not to impose its requirements in this area, but instead to defer to State regulatory bodies.

Paragraphs 7c and 7d reflect the general responsibilities of EH and NS with respect to this Order. In neither instance are any responsibilities given to these organizations that are not already specified in other DOE Orders or SEN documents.

Paragraph 7e provides the mechanism for delegation and re-delegation of authority, so even though responsibilities and authorities are specified only for Program Secretarial Officers and Operations Office Managers, it is clear that those individuals are not required to be directly involved in all actions.

## 8. GENERAL REQUIREMENTS.

In laying out the requirements for an accelerator facility in this paragraph and those following, it was found that the least ambiguity arose when the facility was viewed as a whole, while recognizing there may be specific occasions or specific facilities for which it is more logical to address the Order's requirements by dividing the facility into discrete modules. The two most obvious modules are the two facility components that generate and use the accelerated particle beam: the accelerator, and the experimental areas.

Three activities at accelerator facilities have been identified by the Order as requiring review and approval: initiation of accelerator facility commissioning (including initial experimental setups); commencement of routine operation of the accelerator; and resumption of an activity stopped by DOE for safety reasons (including the discovery of an Unreviewed Safety Issue).

Paragraph 8a reaffirms that the Order is not intended to replace any other ES&H Orders that have applicability to accelerator facilities.

Although paragraph 8b specifies that the hazard classification process to be used is that provided in DOE 5481.1B, in the event that the process for non-nuclear facilities is superseded by more refined guidance, it is intended that accelerator facilities utilize that refined guidance. At the same time, the requirements contained in DOE 5480.25 specific to DOE approval of the hazard class of the activity, which are more stringent than those currently in DOE 5481.1B, would be retained.

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Paragraph 8c states DOE's intent to make a formal finding that the risks presented by significant activities at accelerator facilities are acceptable before they will be permitted to be undertaken. Recommencement of accelerator operation after an extended period of inactivity because of programmatic, rather than safety, reasons was purposefully omitted from the conditions requiring DOE authorization. Accelerator components and systems do not have the potential for significant deterioration such that the risks posed by the operation will have changed (however, note the discussion below on paragraph 12a(5) for an exception to this regarding personnel qualification).

Paragraph 8d is intended to require that the bounds of safe operation for all activities covered by the Order be identified. This is currently required by DOE Orders only for nuclear activities. The paragraph also implies that the bounds of safe operation are to be agreed-to by DOE. [This is addressed further by paragraphs 8d, 10d, 10e, 11a, and 11b of DOE 5480.25.]

Paragraph 8f is intended to establish the general concept that contractors must identify those tasks which could, if not performed as required, have an adverse affect on safety and health conditions; and then to assure that only fully trained and qualified individuals perform these tasks.

Paragraph 8g is intended to validate the use of a graded approach in the implementation of the specific requirements of the Order. In practice, this has always been the way Orders have been implemented. With DOE's increasing emphasis on strict compliance with requirements imposed by the various ES&H Orders, it was felt advisable to specifically highlight this concept as being applicable to avoid as much as possible the unnecessary expenditure of resources without commensurate benefit. In identifying the graded approach as applicable, this Order parallels the explicit use of this concept in DOE 5480.19, "Conduct of Operations Requirements for DOE Facilities" (see paragraph 5b of that Order), and in DOE 5480.23, Nuclear Safety Analysis Reports (see paragraph 8a of that Order).

Paragraph 8h is intended to require that the basis for an exemption to any requirement of the Order be presented in the Safety Assessment Document (SAD), where its context in the overall picture of the safety features provided and safety precautions taken can be more readily evaluated. This would not necessarily require the SAD to be revised; the basis for an exemption could be made an addendum to the SAD.

## 9. ACCELERATOR FACILITY DESIGN AND OPERATION REQUIREMENTS.

A number of items included in this section in earlier drafts of this Order were not retained once the "value added" concept discussed in the Introduction to this Background document was applied. For example, at one point it was felt desirable to identify more specifically what the term "Class A equipment", as used in DOE 5000.3A (the Order on occurrence reporting), meant for accelerator facilities. This has now been deleted in favor of putting information on the application of this term into the guidance that will be provided by the DOE program offices for implementing DOE 5480.25, rather than having it in the Order as a required interpretation of that term.

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Having said all this, the wording of paragraph 9a(1) would appear to add nothing to what is already required by DOE 5480.11. What is intended here is an increased awareness of the contribution that the coupling of all three types of protective measures can make to the prevention of unacceptable exposure of personnel to prompt ionizing radiation.

The paragraph 9a(2) bypassing requirement is intended to be applied to active and passive safety systems. Relief from administrative measures is governed by its own distinct process.

Paragraph 9b is intended, in part, to require that control of access for safety purposes be provided during periods when the accelerator is not operating or an experimental area is not in use. The non-operational condition referred to here is the interim period between normal uses of the facility (or any part of it); it does not apply to a facility that is permanently shutdown. The Order does not require the plan called for by this paragraph to be submitted to DOE for approval. It was felt that the plan would get sufficient review in the normal course of scrutiny that the facility will receive (such as the review called for by paragraph 13a of DOE 5480.25).

Paragraph 9c(1) was included to make clear that interlocks must be employed to the extent feasible to protect personnel from hazards associated with non-ionizing radiation and other injurious environments, as well as from ionizing radiation.

Paragraph 9c(2) is intended to ensure protection of all persons, whether their activities could affect safety and health conditions for others, or whether their own safety and health could be affected by facility activities. From the way the definition of "accelerator facility" has been cast, this would include all persons permitted in the facility.

The statement on shielding policy called for by paragraph 9c(3) has not been required to be submitted to DOE for approval. It was felt to be sufficient to review the manifestations of this policy in specific applications as they appear.

Paragraph 9c(4) is present because accelerator facilities often have particles and energy levels not encountered elsewhere.

Paragraph 9c(5) is stated very broadly with the intent to require that all potentially hazardous environments have well-understood characteristics, that persons potentially exposed to the hazards be reminded of their presence by appropriate signs and other means, that the hazardous conditions be monitored with a periodicity appropriate to their magnitude and potential for change, and that the conditions found in monitoring be recorded and the records maintained.

The requirement stated in paragraph 9c(6) is included because modifications have the potential of creating unexpected conditions, and also because some accelerator facilities that have been in operation for years have been found in recent times to have a less than desirable understanding of the shielding characteristics of their facility, particularly when the facility has been

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expanded beyond the original operating parameters or design. Early versions of this requirement were more specific in how the adequacy of the shielding was to be established: comprehensive beam fault measurements were called for. Some of the experts contributing to the earlier reviews felt it was too constraining in that it did not permit calculations and extrapolations.

In recognition of the desirability of early establishment of the hazard classification of an accelerator facility (or a module thereof), **paragraph 9d** calls for an analysis supporting the determination of the hazard class of the activity to be made as early as possible. Submitting that evaluation and establishing the hazard class of the activity early could save unneeded analysis later on at one end of the spectrum, and expensive program delays at the other end of the spectrum if safety authorization to initiate commissioning is not forthcoming because of insufficient analysis and documentation.

**Paragraph 9e** institutionalizes a version of the long standing voluntary process known as APARS (Advisory Panel on Accelerator Radiation Safety). This process has wide acceptance and has proven very helpful. In imposing this requirement, it was not felt that such Panels in the future must necessarily be appointed by the PSO.

**Paragraph 9f** does not intend to require DOE approval of the procedures required by the paragraph. As with other actions assigned to the contractor, the Department always has the option of requiring the submission of material for its prior approval. The 3-year time period specified in the paragraph was selected as a trade-off between an unnecessarily burdensome shorter period, and an excessively long period that could thwart the intent of the requirement, which is to affirm the procedures' continued validity for their intended purpose. This frequency may not be sufficient for some accelerators, which is acknowledged by the words "not to exceed" in the requirement. In each case, contractors would be expected to establish the appropriate frequency. Operations management has the responsibility for maintaining required procedures current on a day-by-day basis as systems and conditions are changed.

**Paragraphs 9g and 9h** are intended to amplify the general requirement in paragraph 8f. While this subject, operator qualification, is developed in detail in paragraph 12, it was felt that the aspect covered here in paragraphs 9g and 9h is more appropriately included under operations than under training. At newly constructed accelerators, the development staff (i.e., specialists) and/or beam physicists are likely to be the only knowledgeable experts, since most DOE accelerators are truly one-of-a-kind devices. These individuals would therefore be expected to have an important role in the training of the permanent operating staff. It would be expected that certain of these specialists and beam physicists would constitute the original operating staff until the training of others is accomplished, which cannot be completed until the performance characteristics of the accelerator are determined.

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In contrast to the three-year frequency called for in paragraph 9f, a one-year frequency has been specified in paragraph 9i for review of the continued validity of safety-related procedures associated with experimental activities because of the often dynamic nature of many experiments. Consideration was given to making this requirement less specific by saying "periodically" rather than "annually". Concern that a lack of specificity would lead to endless discussion and acrimony over the appropriate periodicity prompted the selection of a specific periodicity. Another distinction between paragraphs 9i and 9f is that paragraph 9f is intended to require that accelerators be operated employing safety-related procedures, and Paragraph 9i is intended to require the same for experiments.

In paragraph 9j, "accelerator development programs" is intended to refer to developmental programs using an accelerator for which DOE authorization of Routine Operation has been given, and where modified performance characteristics of the accelerator itself are the focus of the effort rather than the utilization of its beam. Operating the accelerator for this purpose could potentially take it beyond the bounds of its approved Accelerator Safety Envelope. It is not the intent of this paragraph to permit operation of the accelerator in violation of the established Accelerator Safety Envelope. An awareness of the need to remain within DOE-approved safety bounds is vital, which is the reason the Order requires a review of the proposed development program and any special precautions to be imposed to ensure that the safety envelope will not be violated. (An acceptable alternative to this would be to prepare a safety analysis and propose a safety envelope which is specific to the development program and based on that analysis.)

The process for exempting the development program from some of the specific provisions of the Order was specifically provided for in paragraph 9j to provide an explicit statement of this relief option for those programs where justified, and to specify the coordination considerations for the approval of an exemption request.

#### 10. SAFETY ANALYSIS REQUIREMENTS.

The intent of this paragraph is to adapt the requirements of DOE 5481.1B, SAFETY ANALYSIS AND REVIEW SYSTEM, so that they are specifically applicable to accelerator facilities. In meeting the requirements presented in this paragraph, it is intended that the facility will be meeting the requirements of DOE 5481.1B. This paragraph is intentionally written more prescriptively than most of the other paragraphs to provide a more comprehensive understanding of what is required of whom, and when.

Paragraph 10a allows the flexibility of dividing the accelerator facility into two or more discrete modules for safety analysis purposes. The reason behind this was to permit, for example, the injector or an experimental area to be addressed separately from the accelerator where this could facilitate review, approval and staged commissioning/operation of the facility.

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Paragraph 10a also specifically calls out three subject areas to which each safety analysis should give special attention: electrical safety, cryogenic safety, and egress [i.e. life safety]. These are areas that commonly present safety concerns of some magnitude. Except for the egress issue, they do not present any unique problems; it is their widespread presence at most accelerator facilities that makes them candidates for special treatment in a safety analysis.

Paragraph 10f addresses two aspects of experimental activities. The first is intended to provide assurance that experimental apparatus will be designed, fabricated and used in such a manner that it does not present unacceptable risks or introduce an Unreviewed Safety Issue. By requiring that safety standards for experimental apparatus be established by the contractor, it was felt that the safety requirements for experiments would be better understood by the experimenters before the fact, so that time and resources are not wasted and DOE approval for experiments, when required, will be timely. The second aspect addressed is intended to provide a consistent process for before-the-fact safety reviews of experimental apparatus before it is coupled to the accelerator to assure that the safety standards required by the contractor have been correctly applied to the apparatus.

Paragraph 10j requires a Preliminary Safety Assessment Document to be prepared only under specific conditions imposed by DOE 4700.1. This limited requirement was felt to be sufficient because accelerator facilities do not generally contain hazards of such types and magnitudes that will cause them to be classified as high hazard facilities. The design of the safety features of the facility will not be so critical or so complex that the independent review required by paragraph 9e will not suffice to assure DOE that adequate precautions are being taken. Where safety authorization prior to construction is determined by DOE to be advisable, DOE always has the prerogative of requiring the contractor to perform a detailed safety analysis, and to start substantial construction only after being authorized by DOE.

## 11. RISK ACCEPTANCE PROCESS REQUIREMENTS.

Paragraph 11c is intended to ensure that the specific information used, the factors considered, and the process employed in arriving at the conclusion that the activity under consideration does not present an unacceptable risk, is documented by the organization granting the approval.

Paragraph 11d places the requirement to perform Accelerator Readiness Reviews on the contractor rather than DOE because it was felt that the contractor should assume the prime responsibility for assuring that it is ready to safely initiate a new phase of its activities. DOE is given the responsibility (paragraphs 11a and 11b) to satisfy itself that the contractor's readiness review was appropriately thorough. DOE is also given the responsibility (paragraphs 11f and 11g) to verify that the findings of a readiness review have been satisfactorily addressed by the contractor. Even in the event that DOE decides to conduct its own readiness review as the means by which it discharges its responsibilities, it is not intended that the contractor be relieved in any way of its responsibilities in this regard. Elaboration on

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how DOE might discharge its responsibility on this matter, as well as elaboration on the content of contractor readiness reviews, were felt to be more appropriately covered by guidance issued by the Program Secretarial Officers than by inclusion in the Order.

Paragraph 11e acknowledges that different segments (modules) of an accelerator may go through the commissioning process separately, although the documentation required and the number of separate authorization actions on the part of DOE encourage that an overall program for commissioning be established. This lessens the involvement required by DOE and the chances for unforeseen delays in obtaining a number of discrete authorizations.

Paragraph 11h specifies a mechanism for establishing whether an accelerator facility is required to follow the risk acceptance requirements of paragraph 10, or whether it is largely exempt from them. DOE 5481.1 does not specify how the determination is to be made on whether an activity comes under that Order. This problem hopefully has been avoided for accelerator facilities by providing a subjective definition of "routinely accepted" as the fourth hazard class. This definition can be found along with those for the other hazard classes in footnote 1/ of the Attachment to the Order.

## 12. PERSONNEL TRAINING AND QUALIFICATION REQUIREMENTS.

This paragraph amplifies the general requirement stated in paragraph 8f by identifying the major elements of the program. The paragraph addresses not only training, but also the mechanism for formally declaring that an individual is fully qualified by training and experience to perform the assigned work and the records needed to permit the program to be evaluated and/or audited by management (contractor and DOE). The fundamental premise underlying the approach spelled out is that the contractor is fully responsible for carrying out the training and the qualifying of individuals. There will not be day-to-day involvement by DOE.

Paragraph 12a(5) has intentionally avoided using the term "certification". This term can have unnecessary implications where the involved individuals are members of labor unions. Also, for some professions, "certification" carries the connotation of a performance standard established by some external authority, which is not the case here. "Qualification" is the result of management's formal acknowledgement of its determination that an individual has the knowledge and skills to safely perform certain types of duties.

Paragraph 12a(5) also calls for periodic re-qualification, but does not give the time interval, leaving that to the contractor to specify, in recognition of the considerable variation from one accelerator facility to another in what is meaningful. Accelerators that operate year-round would likely have much longer intervals between required re-qualification than those that have long seasonal shutdowns. In this latter case, annual re-qualification would appear reasonable.

With deliberate intent, task-specific training called for by paragraph 12b(1) has not been restricted to safety-related matters. All task-specific training is likely to have some relevance to safety, although not always directly. A strong case can be made that proper performance of tasks is synonymous with safe performance: the two are not readily separable. It is difficult to segregate portions of tasks having safety importance from those without importance to safety, and if achieved would make training fragmented and, at best, inefficient [if not ineffective].

Paragraph 12b(2) was included at the insistence of EH, which felt that instilling diagnostic ability in operators would enable abnormal operations to be detected early so that the more serious accidents would be prevented. While this is of considerable importance for many nuclear facilities, it is of marginal importance for accelerator operation, where it enhances mainly operational efficiency.

Paragraph 12c(1) requires safety-related training for maintenance and support personnel, but does not provide any further delineation of criteria to be used in determining what structures, systems, and components should be considered to be "safety-related". This will vary from one facility to the next. By remaining silent, it was intended that the contractor make the case for what should be covered, drawing heavily from the Safety Assessment Document, when it undertakes to develop the training program required by the Order.

### 13. CONTRACTOR INTERNAL SAFETY REVIEW SYSTEM REQUIREMENTS.

Formal internal review is currently explicitly required only for nuclear facilities. It is addressed in DOE 5480.5 and DOE 5480.6 under the heading "Contractor Independent Review and Appraisal System". The concept is felt to have merit for accelerator facilities, and the nuclear facility requirements have been modified to make them more appropriate for accelerator facilities. The word "internal" is included in the accelerator Order heading to indicate that the system is expected to use contractor personnel, although this is not made mandatory. A description of the most important differences between the nuclear safety requirements and the accelerator safety requirements follows.

Paragraph 13a intends that a committee process be employed to accomplish at least the bulk of the effort required. The conjunctive "and/or" is used to convey the concept that either or both types of committees (standing and ad hoc) can be employed to meet the requirement. The nuclear facility requirements are silent on the matter of employing committees, requiring only that the system provide for "group discussions between reviewers".

The degree of independence required of the system is the most significant departure from the nuclear facility requirements. It is greater for nuclear facilities, as would be justified by the potential consequences of biased conclusions. The word "independent" has been dropped from the title, and appears only in paragraph 13a(6), although objectivity is required in the reviews called for in paragraph 13a(5).

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Paragraph 13a(5)(f) intends that only the causes found for an Accelerator Safety Envelope violation be reviewed, not that the internal safety review system must review the event itself or other unusual occurrences. With the significance level for reporting of occurrences to DOE that has been established by DOE 5000.3B, it was felt that the involvement of the internal safety review system in each occurrence should not be mandatory. The contractor can always use the internal safety review system to review a specific occurrence if it so chooses.

Paragraph 13a(7) calls for biennial audits of safety, whereas these are required to be done annually at nuclear facilities. The difference in frequency reflects the significantly smaller potential consequences of the failure of an engineered safety feature or administrative control compared to nuclear facilities.

Paragraph 13c requires the internal safety review system to be evaluated for its performance at least every 5 years, while the same requirement for nuclear facilities is 3 years. The 3 year requirement stems from a general requirement in DOE's safety appraisal Order, DOE 5482.1B, that there be an appraisal every 3 years of management effectiveness in carrying out assigned safety responsibilities. Again, the difference in the minimum frequency recognizes the difference in the consequences should the system not be performing as intended. Also, with the heightened awareness of management's responsibility to assure that DOE safety and health requirements are being met, if management senses that the system is not providing it with the unbiased and technically sound advice it needs, those weaknesses are very likely to be corrected as they are detected, and management will likely initiate a top-to-bottom review without waiting for the 5-year clock to run out. In such a safety conscious environment, the formal review called for by this requirement serves mainly as a backup to look into all the nooks and crannies of the system to assure a comprehensive understanding of its workings. For both of these reasons, the 5-year interval seems reasonable.

#### 14. IMPLEMENTATION REQUIREMENTS.

This paragraph addresses the process for bringing operating facilities and those in advanced stages of construction or modification into compliance with the Order. Key to this effort as the Order is written is the issuance of implementing guidance by the responsible Program Secretarial Officer (PSO). Implementing guidance has not been made an attachment to the Order. By decoupling the guidance from the Order, it was felt that guidance could be changed more readily as experience with implementing the Order was obtained. One of the basic responsibilities of each PSO under the current DOE management philosophy is to provide guidance to its contractors in the implementation of ES&H Orders. The guidance required by the Order is viewed as a mechanism for partially discharging that responsibility. Also, experience has shown that where guidance has been made part of a safety Order, compliance-oriented oversight groups have tended to blur the distinction between requirements and guidance, and to treat the guidance as additional requirements.

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Accelerator facilities in the planning stage or in the early stages of construction should not need to develop an implementation plan. Those facilities can integrate the requirements of this Order into their planning and design. The requirements will be reflected in the content of the Safety Assessment Document, the training program, the procedures, the readiness reviews and other activities routine to readying the facility to accomplish its program mission.

This paragraph is intentionally silent on the matter of requiring justification for continuing to operate existing accelerator facilities until such time as the Order's requirements are appropriately implemented. It was not intended that any authorization to continue operations and experimental programs should be needed. This is predicated on the Implementation Plan providing a responsive and timely schedule for compliance. If this is not forthcoming in some instances, one way for the Department to reduce its vulnerability would be to require a contractor to provide such justification.

Paragraph 14a requires the contractor to submit an implementation plan for meeting the requirements of this Order, and gives the purposes to be served by that plan. It requires the plan to be submitted to DOE within six months of receiving guidance on the implementation of the Order from the responsible PSO. That guidance will provide instructions and suggestions on how to carry out the intent of the various requirements, and has as one of its purposes the promotion of greater uniformity of implementation from facility to facility. DOE believes that six months is ample time to develop such a plan given the straightforward nature of the bulk of the requirements, and the preparatory planning that can take place even without the supporting details that will be in guidance.

The wording of paragraph 14b(1) is intended to recognize that there could be in existence some safety analyses of the accelerator facility that have been documented, and to allow credit for this even though it may not be in the form being called for by DOE 5480.25. Only if the accelerator facility poses "significant potential hazards" (i.e., can be classed as moderate- or high-hazard) that have not been analyzed for their consequences using methodologies that are currently acceptable, or an analysis has been made but not documented, will it be necessary to undertake additional efforts in this area.

Paragraph 14b(2) specifies 18 months as the time within which the contractor is to fully meet the training requirements of the Order. It is not expected that most contractors will require this much time to construct the training program and apply it to current personnel. Contractors can expect their proposals to be carefully reviewed to determine whether their schedules are reasonable. Alternative consideration was given in using 12 months as the grace period, and to grant exceptions when a good case could be made by the contractor for not accomplishing the effort within that time. The current approach removes some of the burden of proof from the contractor and allows the program organization to share responsibility for setting a reasonable schedule.

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Paragraph 14b(4) provides a mechanism for existing facilities to show equivalence to a specific requirement of the Order in lieu of making changes which would bring them into literal compliance with the requirement. Inclusion of the word "demonstrated" allows the possibility of long-standing operating experience to be given consideration.

ATTACHMENT.

The title of the table that comprises this attachment contains the word "minimum". The purpose of including this modifier was to convey the concept that the responsible DOE program organization has the inherent right, on a case by case basis, to impose more stringent approval levels than called for by the Order. DOE safety directives have always been recognized as providing minimum requirements for safety, and in a very general way, this is recognized in the basic DOE safety directive, DOE 5480.1B, in the RESPONSIBILITIES AND AUTHORITIES paragraph for PSOs and heads of field organizations by the inclusion of the responsibility that they "shall take such action as may be appropriate to ensure safety".

The Attachment identifies four hazard classes, because they are the system currently specified by DOE (in DOE 5481.1B). The argument can be made that a "typical" accelerator should always be in the low hazard class because any accident tends to dissipate the particle beam and lower the hazard associated with the operation. The proof remains with the contractor; the Order is written to accommodate all eventualities.

END