The Use of a Graded Approach in the Application of Safety Requirements for Research Reactors

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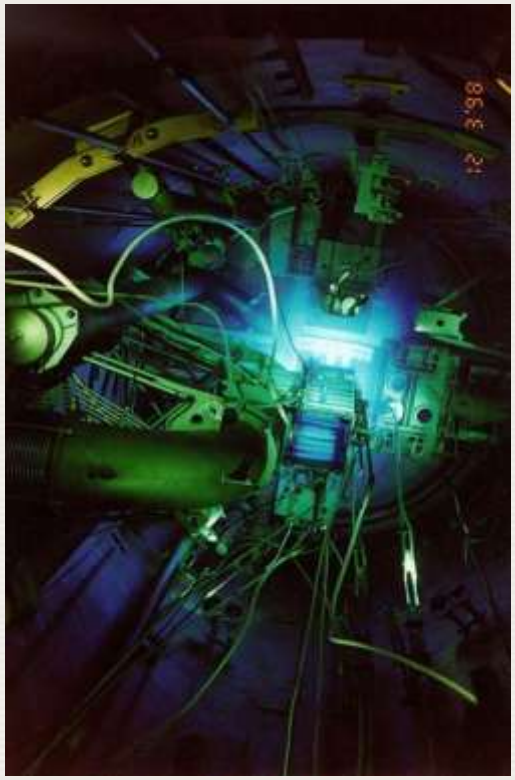
Graded Approach: Why Grading?



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Graded Approach: Definition

- The level of analysis, verification, documentation, regulation, activities, and procedures used to comply with a safety requirement, should be commensurate with the potential hazard associated with the facility without adversely affecting safety.

Graded Approach

Graded approach is a common sense based on:

- Hazard and potential impact (risks) associated with safety, health, and environment;
- Safety analysis and engineering judgement;
- Significance and complexity of each activity;
- Experiences of the staff involved;
- Possible consequences in case of failure;
- Maturity level of the technology and operating experience associated with the activities;
- Lifecycle stage of the facility.

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Reference to Grading Approach

The concept of grading the application of safety requirements is not new and it is mentioned in high level documents of the IAEA**:**

- Fundamental Safety Principles SF-1, 2006: Principle 3:
  Safety has to be assessed and periodically reassessed throughout the lifetime of facilities and activities, consistent with a graded approach.

- Fundamental Safety Principles SF-1, 2006: Principle 5:
  Resources devoted to safety by the licensee and the scope are to be commensurate with the magnitude of the potential radiation risks.

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IAEA Safety Guide on Graded Approach (DS351)

- The IAEA Safety Standard DS351, which is under publication, provides guidance on the use of the Graded Approach for Research Reactors, as specified mainly in the Safety Requirements document NS-R-4 and the General Safety Requirements document GS-R-3.
- The Graded Approach is used to determine the appropriate manner to comply with a safety requirement; it is not used to provide relief from a requirement, (it is not a waiving approach or grading to zero).
- Any grading performed should ensure that safety functions and Operating Limits and Conditions are preserved and that there are no negative effects on the facility staff, the public, or the environment.

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IAEA Safety Guide on Graded Approach (DS351)

- The document is intended to support and facilitate the use of safety requirements document NS-R-4 and safety guides dedicated to research reactors, with respect to the graded approach throughout all important activities of the lifetime of a RR.
- Document follows closely the format of Safety Requirements of Research Reactors, NS-R-4, it also quotes other general Safety Standards GS-R-3 and GS-G-3.1.
- Intended for use by Operating Organizations, Regulatory Bodies and Organizations involved with design, construction and operation of RR's.

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Document Style

- Identifies whether a safety requirement can be graded or not.
- Provides lists of parameters relevant to the safety requirements.
- It does not provide a cookbook or quantitative ranking procedure for grading.
- Rather, it provides guidance on the safety parameters for which the level of detail required may be optimized, commensurate with the relative importance to safety.

Content of DS 351 (from NS-R-4 structure)

1. Introduction
2. Basic elements of the approach to grading
3. Regulatory supervision
4. Management of supervision
5. Site evaluation
6. Design
7. Operation
8. Decommissioning
9. Annex : Example of Transport Package Classification grading

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DS 351 Structure

- This Safety Guide summarizes briefly the main safety requirements and discusses whether grading is applicable.
- If grading is applicable then a list of gradable parameters or criteria associated with safety is provided.
- Detailed examples of quantification or application of grading is not discussed in the document, except for the annex example.

Graded Approach: Examples of factors to be considered

Safety requirements should be applied in such a way that the levels of analysis, documentation and actions are commensurate with the **potential hazard** associated with the facility, **without adversely affecting safety**.

The factors to be considered are:

- ✓ Reactor power;
- ✓ Radiological source term;
- ✓ Amount and enrichment of fissile and fissionable material;
- ✓ Spent fuel elements, high-pressure systems, storage of flammables;
- ✓ Type of fuel elements;
- ✓ Type and mass of moderator, reflector, coolant;
- ✓ Amount and rate of reactivity that can be introduced;
- ✓ Reactivity control;
- ✓ Quality of containment / confinement;
- ✓ Utilization (experimental devices, tests, experiments);
- ✓ Siting;
- ✓ Proximity to population.

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Examples of topics to be considered for grading

- Detail of procedures instructions
- Review, Approval and authorization of documents
- Review, Approval and authorization of utilization or modification
- Training/retraining programme
- Regulatory Inspection programme
- Internal audit/inspection programme
- Emergency preparedness
- Management/QA system
- Self assessment programme
- Maintenance/calibration frequencies

Transport Package Classification: Assignment of a quality grade category to each component (TS-G-1.4)

Quality Category	Safety Classification	Consequences of Failure
Grade 1	Critical	Directly affecting package leak tightness or shielding. Directly affecting geometry and criticality control, in packages of fissile material.
Grade 2	Major impact on safety	Failure could indirectly affect safety, in combination with a secondary event or failure. Example is impact absorber between primary and secondary containment systems.
Grade 3	Minor impact on safety	Affecting SSCs whose malfunction would not affect the effectiveness of the packaging and would be unlikely to affect safety. Examples include devices that indicate tampering e.g. security locks.

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Graded Management Controls (indicative listing)

Graded Management Controls Quality	Grade 1	Grade 2	Grade 3
Design is based on the most stringent industry codes or standards, and the design verification is accomplished by prototype testing or formal design review.	X		
Suppliers have a management system based on applicable criteria established in an acceptable national or international standard.	X		
Manufacturing planning specifies complete traceability of raw materials and the use of certified welders and processes.	X		
Procurement documentation for materials for services specifies that only suppliers from qualified vendor lists are used.	X	X	
Only qualified auditors and lead auditors perform audits.	X	X	
Only the lead auditor should meet certain qualification requirements.		X	
Verification activities still require use of independent inspectors qualified to appropriate codes, standards or other industry specifications.		X	X
Procurement of materials does not need to be from a qualified vendor list.			X
Items are purchased from a catalogue of ‘off the shelf’ items.			X
Self-assessments rather than independent assessments are the primary method for assessing and verifying performance.			X
Records are maintained in temporary files for a specific retention period (e.g. six months) after shipment.			X

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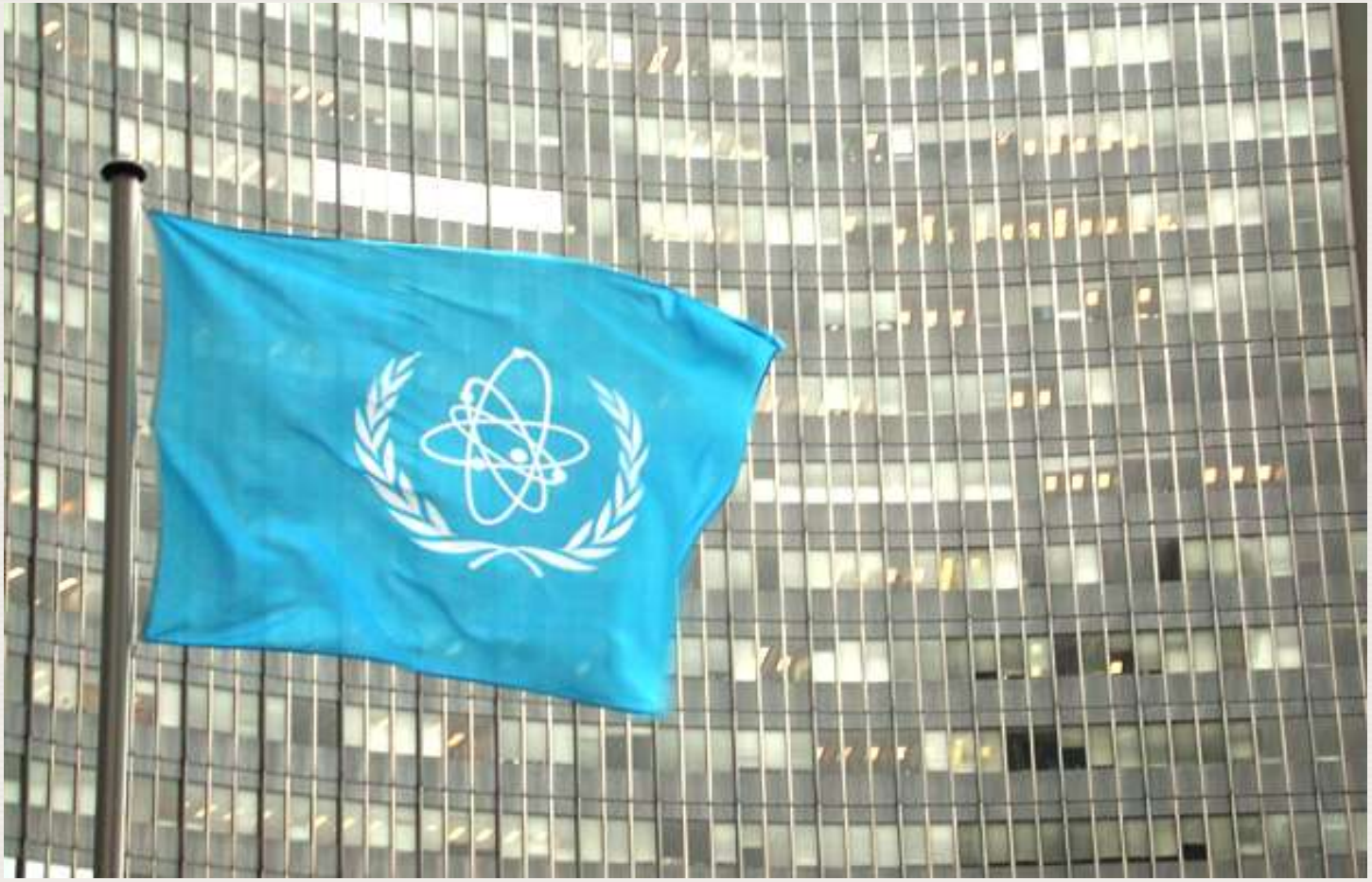
Thank you for your attention!



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