



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

May 7, 2019

MEMORANDUM TO: Brian E. Thomas, Director  
Division of Engineering  
Office of Nuclear Regulatory Research

FROM: Eric J. Benner, Director */RA/*  
Division of Engineering  
Office of Nuclear Reactor Regulation

SUBJECT: RESULTS OF PERIODIC REVIEW OF REGULATORY GUIDE  
(RG) 1.136

This memorandum documents the US Nuclear Regulatory Commission (NRC) periodic review of regulatory guide (RG) 1.136, "Design Limits, Loading Combinations, Materials, Construction, and Testing of Concrete Containments." Revision 3 of the RG, published in March 2007, describes guidance on loads and load combinations, design and analysis, and a method for determining the ultimate capacity of concrete containment. The RG describes an approach that the staff of the U.S. Nuclear Regulatory Commission (NRC) considers acceptable for use in the design and construction of concrete containment for satisfying the requirements of General Design Criteria (GDC) 1, 2, 4, 16, and 50, specified in Appendix A, "General Design Criteria for Nuclear Power Plants," to Title 10, Part 50, of the Code of Federal Regulations (10 CFR Part 50), "Domestic Licensing of Production and Utilization Facilities".

As discussed in Management Directive 6.6, "Regulatory Guides," the NRC staff reviews RGs approximately every 10 years to ensure that the RGs continue to provide useful guidance. Documentation of the NRC staff review is enclosed.

Based on the results of the periodic review, the staff concludes that a revision to RG 1.136 Revision 3 is warranted. The proposed Revision 4 of the guide has been initiated and is currently in progress with the purpose of endorsing the 2017 Edition ASME B&PV Code, Section III, Division 2, as well as address code cases associated with Division 2. A draft of this revision will be sent to RES/RGGIB in Quarter 4 FY 2019, with a planned release for public comment in Quarter 1 FY 2020.

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Enclosure:  
As stated

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(RG) 1.136 DATED: May 7, 2019.

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DATE	05/02/19	05/03/19	05/07/19

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**Regulatory Guide Number:** 1.136, Revision 3

**Title:** Design Limits, Loading Combinations, Materials, Construction, and Testing of Concrete Containments

**Office/division/branch:** NRR/DE/ESEB  
**Technical Lead:** George Thomas

**Staff Action Decided:** Revise. The revision will endorse, with conditions as warranted, the ASME Code, Section III, Division 2, 2017 Edition, as well as address Code Cases related to Division 2. This proposed draft Revision 4 of the RG has been initiated and is in progress.

**1. What are the known technical or regulatory issues with the current version of the Regulatory Guide (RG)?**

Regulatory Guide (RG) 1.136, "Design Limits, Loading Combinations, Materials, Construction, And Testing of Concrete Containments," Revision 3, was published in March 2007. This endorses with exceptions, the 2001 Edition of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section III, Division 2, "Code for Concrete Containments," hereafter referred to as "the ASME Code, Section III, Division 2." Since the last revision of RG 1.136, the Code has been updated several times, the most recent being the 2017 Edition. The revisions documented in ASME editions from 2004 with 2006 Addenda through 2010 edition had no impact on RG 1.136 since they were mostly editorial/typographical corrections.

The current revision of RG 1.136 does not reflect the changes documented in the 2010 with 2011 Addenda, 2013, and 2015 editions of the Code, which were significant. The changes ranged from the design of the concrete mix (including adding provisions to improve the ability of concrete to resist alkali-silica reactivity and sulfate attack), the design and testing of anchorage components, clarifying the definition of development length for headed bars in tension (by including a new equation and adding a definition for critical section and  $I_{dt}$  taken from ACI 318), to the tightening of requirements for provision of radial reinforcement in prestressed concrete containments.

The 2015 edition of the Code has incorporated the requirement contained in the last revision of RG 1.136, regarding the tangential shear strength provided by orthogonal reinforcement (Regulatory Position C.5), to align the requirements with ACI-349 and ACI-318, but does not differentiate between existing and new plants. Further, the 2017 edition included several additional clarifying revisions. Code Cases associated with the ASME Code, Section III, Division 2, that were approved for use and those not approved for use were inadvertently listed in RG 1.84 and RG 1.193, respectively, previously and not in RG 1.136 where it belongs. The disposition of code cases associated with Division 2 of the ASME Code that are approved for use and those that are not approved for use will need to be included in RG 1.136.

Regulatory Guide 1.136 Revision 3 (March 2007) is the current revision and it is still valid as written for existing and newly licensed nuclear power plants with concrete containments. With the constant advancement in knowledge of concrete behavior and

design, the revision of current codes and standards and the revision of other regulatory guides referenced in this regulatory guide (such as RG 1.107), RG 1.136 is currently being revised to endorse the 2017 edition of the ASME Code, and address the changes alluded to herein as well as code cases associated with Division 2.

**2. What is the impact on internal and external stakeholders of not updating the RG for the known issues, in terms of anticipated numbers of licensing and inspection activities over the next several years?**

There is no impact on internal and external stakeholders of not updating Regulatory Guide 1.136. However, the guide is being revised to endorse, with regulatory positions as warranted, the 2017 edition (most recent published edition at the time of this periodic review) of the ASME Code, Section III, Division 2, as well as address Code Cases associated with Division 2.

**3. What is an estimate of the level of effort needed to address identified issues in terms of full-time equivalent (FTE) and contractor resources?**

0.5 FTE is the estimated resource need.

**4. Based on the answers to the questions above, what is the staff action for this guide (Reviewed with no issues identified, Reviewed with issues identified for future consideration, Revise, or Withdraw)?**

Revise Regulatory Guide 1.136 with the purpose of endorsing the 2017 edition of the ASME Code, Section III, Division 2, with exceptions as warranted as well as address code cases associated with Division 2. This proposed Revision 4 of RG 1.136 has been initiated and currently in progress.

**5. Provide a conceptual plan and timeframe to address the issues identified during the review.**

The proposed Revision 4 of Regulatory Guide 1.136 has been initiated in the third Quarter of Fiscal Year 2019 with the purpose of endorsing ASME B&PV Code 2017 Edition. A draft of this revision will be sent to RGGIB in Quarter 4 FY 2019, with a planned release for public comment in Quarter 1 FY 2020.

**NOTE: This review was conducted in May 2019 and reflects the staff's plans as of that date. These plans are tentative and subject to change.**