Regulatory Guide 1.200 Revision 1 – Issue for Use

Nuclear Regulatory Commission

Public Meeting
June 16, 2005

Purpose of Meeting

- Discuss status of Revision 1 to Regulatory Guide (and Standard Review Plan Chapter 19.1)
  - Revisions to 1.200
  - Schedule
- Category 2 meeting

Agenda

- Introduction
  - History and Background
- Status
- Revisions to RG 1.200
- Schedule

Introduction -- History

- ASME published ASME RA-S-2002 “Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications”
  - Addendum A, December 2003
- NEI provided “Self-Assessment Process” to address differences between ASME standard and NEI 00-02
- NRC published RG 1.200 for trial use, February 2004
- Industry pilots on RG 1.200 (June 2004 to March 2005)
- ASME published Addendum B, December 2005
- NEI published Revision to NEI-00-02, May 2006

Purpose of Regulatory Guide

- Approach for determining that the technical acceptability of the PRA is sufficient to support the risk-informed decision-making
- When used in support of an application, should obviate the need for an in-depth review of the PRA by NRC staff
- Provide for a more focused and consistent review process
- A major technical guidance document in achieving Phase 3 of the staff's phased approach to PRA quality support risk- informed regulatory activities

Regulatory Guide

- Guidance provided in four areas:
  - Minimal set of functional requirements of a technically acceptable PRA
  - NRC position on consensus PRA standards and industry PRA program documents
  - Demonstration that the PRA used in regulatory applications is of sufficient technical adequacy
  - Documentation to support a regulatory application

Status

- Five pilots have been completed
- Staff has documented the lessons learned from the pilots
- Changes to RG 1.200 based on
  - the five pilots
  - revisions to ASME standard and industry self-assessment guidance
  - need to support risk-informed regulatory activities

Five Pilots Performed

- Columbia: diesel generator completion time (CT) extension
- Limerick: technical specification 5b initiative (risk-informed test interval)
- South Texas: Technical specification 4b initiative (risk-informed CTs)
- San Onofre: battery CT extension
- Surry: 10 CFR 50.69 application (charging and component cooling water systems)

Revisions to RG 1.200, Main Body

- A. INTRODUCTION
  - Technical editing
- B. DISCUSSION
- C. REGULATORY POSITION
  - Additional position added: “Development, Maintenance and Upgrade of a PRA”
- C.1.1 Scope of PRA: Definitions added on CDF and LERF
  - **Core damage frequency** is defined as the sum of the frequencies of those accidents that result in uncovery and heatup of the reactor core to the point at which prolonged oxidation and severe fuel damage involving a large fraction of the core (i.e., sufficient, if released from containment, to have the potential for causing offsite health effects) is anticipated.
  - **Large early release frequency** is defined as the frequency of those accidents leading to significant, unmitigated releases from containment in a time frame prior to effective evacuation of the close-in population such that there is the potential for early health effects. Such accidents generally include unscrubbed releases associated with early containment failure shortly after vessel breach, containment bypass events, and loss of containment isolation

Revisions to RG 1.200 (cont'd)

- C.1.2 Technical Elements of PRA – clarification added:
  - PRA models of internal flood, internal fire and external hazards are based on the internal events PRA model, modified to include the impact of internal flood, internal fire and external hazards as appropriate
  - PRA results are addressed in an integrated manner
  - Potential conservatisms associated with the successive screening approach used for the analysis of specific scope items such as fire, flooding or seismic are assessed.

Revisions to RG 1.200 (cont'd)

- C.1.3 Attributes and Characteristics
  - Additional clarification added that level of detail is dependent on the application to address different plant stages
  - "The level of detail needed is dependent on the application. The application may involve using the PRA during different plant "stages," i.e., design, construction, and operation. Consequently, a PRA used to support a design certification will not have the same level of detail as a PRA of a plant that has years of operating experience. While it is recognized that the same level of detail is not needed, each of the technical elements and its attributes have to be addressed"

Revisions to RG 1.200 (cont'd)

- C.1.4 PRA Development, Maintenance and Upgrade -- Guidance added to ensure PRA represents the as-built, as-operated plant
  - **PRA Development** – guidance (including attributes and characteristics) provided on use of design, operation, maintenance and engineering information and the need for plant walkdowns
  - **PRA Maintenance and Upgrade** – guidance provided on the process

Attributes and Characteristics for PRA Development

Design	• the safety functions required to maintain the plant in a safe stable state and prevent core or containment damage; • identification of those SSCs that are credited in the PRA to perform the above functions; • the functional relationships among the SSCs including both functional and hardware dependencies; • the normal and emergency configurations of the SSCs; • the automatic and manual (human interface) aspects of equipment initiation, actuation, operation as well as isolation and termination; • the SSCs capabilities (flows, pressures, actuation timing, environmental operating limits); • spatial layout, sozing, and accessibility information related to the credited SSCs; and • other design information needed to support the PRA modeling of the plant.
Operational	• that needed to reflect the actual operating procedures and practices used at the plant including when and how operators interface with plant equipment as well as how plant staff monitor equipment operation and status, and • that needed to reflect the operating history of the plant as well as any events involving significant human interaction.
Maintenance	• that needed to reflect planned and typical unplanned tests and maintenance activities and their relationship to the status, timing, and duration of the availability of equipment, and • historical information related to the maintenance practices and experience at the plant.
Engineering	• the design margins in the capabilities of the SSCs; • operating environmental limits of the equipment; • expected thermal hydraulic plant response to different states of equipment (such as for establishing success criteria); and • other engineering information needed to support the PRA modeling of the plant.

Attributes and Characteristics for PRA Maintenance and Upgrade

- Process is to:
  - Monitor PRA inputs and collects new information
  - Ensures cumulative impact of pending plant changes are considered
  - Maintains configuration control of the computer codes used in the PRA
  - Identifies when PRA needs to be updated based on new information or new models/techniques/tools
  - Ensure peer review is performed on PRA upgrades

Revisions to RG 1.200 (cont'd)

- C.2.1 Consensus PRA Standards – clarification added on what is meant by capability categories
  - "Principle 3 recognizes that the various parts of a PRA can be, and are generally, performed to different "capabilities." The different capabilities are distinguished by the three attributes. That is, in developing the various models in the PRA, the degree to which:
    - the scope and level of detail that reflects the plant design, operation and maintenance may vary.
    - plant-specific information versus generic information is used such that the as-built and as-operated plant is addressed.
    - realism is incorporated such that the expected response of the plant is addressed."

Revisions to RG 1.200 (cont'd)

- C.2.2 Industry Peer Review Program – clarification added that
  - Peer review is to be performed against established standards (as endorsed by the NRC), and if not, needs to be demonstrated the criteria used is consistent with the NRC endorsed standards
  - Process in NEI-00-02 is an acceptable alternative to the process in ASME standard
  - Peer review needed on PRA upgrades

Revisions to RG 1.200 (cont'd)

- C.3 Demonstrating technical adequacy to support a regulatory application
  - Technical editing
- C.4 Documentation
  - GARETH NEED INPUT FROM YOU

Revisions to RG 1.200, Appendix A

- Addendum B to ASME standard only addressed staff objections to Chapter 4 (technical requirements)
- Staff objections in Chapters 1, 2,3, 5, and 6 remain
- Majority of objections in Chapter 4 have been removed

Revisions to RG 1.200, Appendix A -- (Staff position on Chapter 4)

- IE-A4 -- clarifications
  - Cat I and II:
  - PERFORM a systematic evaluation of each system **down to the subsystem/train level**, including support systems.....
  - Cat III:
  - PERFORM a systematic evaluation of each system **down to the subsystem/train level**, including support systems.....
  - PERFORM an FMEA (failure modes and effects analysis) **or other systematic process** to assess...
- IE-B3 -- clarification
  - Cat II:
  - AVOID subsuming **DO NOT SUBSUME** scenarios into a group...

Revisions to RG 1.200, Appendix A -- (Staff position on Chapter 4), cont'd

- IE-C10 -- clarification
  - COMPARE results and EXPLAIN differences in the initiating event analysis with generic data sources to provide a reasonable check of the results.
  - **Pertinent generic data sources include NUREG/CR-5750 [Note (1)].**
- IE-C11 – clarification
  - CC I and II:
  - For rare initiating events, USE industry generic data and INCLUDE plant-specific ~~functions~~ **features in deciding which generic data is most applicable**.

Revisions to RG 1.200, Appendix A -- (Staff position on Chapter 4), cont'd

- IE-C12 -- clarification
  - CC I and II:
  - (a) configuration of potential pathways including numbers and types of ~~values~~ **valves** and their relevant failure modes**, and the** existence**, size,** and positioning of relief valves
- Footnote 3 to Table 4.5.1-2(c) – clarification
  - ... Thus,
  - fbus at power = 1x10-7/hr * 8760 hrs/yr *0.90 = 7.9x10-4/reactor year.
  - **In the above example, it is assumed the bus failure rate is applicable for at-power conditions. It should be noted that initiating event frequencies may be variable from one operating state to another due to various factors. In such cases, the contribution from events occurring only during at-power conditions should be utilized.**

Revisions to RG 1.200, Appendix A -- (Staff position on Chapter 4), cont'd

- AS-A9 – clarification
  - Cat II and III:
  - ....affect the operability of the mitigating systems. **(See SC-B4)**
- AS-A10 -- clarification
  - Cat II:
  - ....INCLUDE for each modeled initiating event, sufficient detail that ~~significant~~ differences in requirements on systems and **required** operator responses interactions **(e.g., systems initiations or valve alignments)** are captured.
- SC-B1 – clarification
  - Cat II and III:
  - ....for thermal/hydraulic, ...requiring detailed computer modeling. **(See SC-B4)** .....

Revisions to RG 1.200, Appendix A -- (Staff position on Chapter 4), cont'd

- SY-A22 – clarification
  - ....is justified through an adequate analysis or examination of data **collected in accordance with DA-C14 and estimated in accordance with DA-D8.** ~~(See DA-C14.)~~
- SY-B10 -- clarification
  - ... required mission time (see also A**S**Y-A6).
  - Examples **of support systems** include:
- SY-B15 -- clarification
  - Examples of degraded environments include:
  - **(h) harsh environments induced by containment venting or failure**

Revisions to RG 1.200, Appendix A -- (Staff position on Chapter 4), cont'd

- HR-A1 – clarification
  - For equipment modeled in the PRA, IDENTIFY, through a review of procedures and practices, those test and maintenance **(including inspection)** activities that require realignment of equipment outside its normal operational or standby status.
- HR-D3 – clarification
  - Cat II, III
  - (a) the quality **(including format, logical structure, ease of use, potential for confusion, and comprehensiveness)** of written procedures and the **quality (e.g., configuration control, technical review process, training processes, and management emphasis on adherence to procedures)** of administrative controls (for independent review)
  - (b) the quality **(e.g., adherence to human factors guidelines [Note (3)] and results of any quantitative evaluations of performance per functional requirements)** of the human-machine interface, including both the equipment configuration, and instrumentation and control layout

Revisions to RG 1.200, Appendix A -- (Staff position on Chapter 4), cont'd

- HR-E2 – clarification
  - (b) those actions performed by the control room staff either in response to procedural direction or as skill-of-the-craft to **diagnose and then** recover a failed function, system or component that is used in the performance of a response action as identified in HR-H1.
- HR-G3 -- clarification
  - CC II, III
  - (d) degree of clarity **of the meaning** of cues/indications
  - (g) complexity of **determining the need for and executing** the required response.
- HR-G4 -- clarification
  - Cat I, II and III:
  - BASE..... **(see SC-B4).** SPECIFY the point in time....

Revisions to RG 1.200, Appendix A -- (Staff position on Chapter 4), cont'd

- DA-C1 – clarification
  - Examples of parameter estimates and associated sources include:
  - (a) component failure rates and probabilities: NUREG/CR-4639 [Note (1)], NUREG/CR-4550 [Note (2)], **NUREG-1715 [Note 7]**
  - **See NUREG/CR-6823 [Note 8] for lists of additional data sources**
- DA-C14 -- clarification
  - ...IDENTIFY instances of plant-specific or **and** applicable industry experience and for each repair, COLLECT....
- Notes to Table 4.5.6-2(c) – clarification
  - (7) NUREG-1715, Component performance study, 1987-1998, Vols. 1-4.
  - (8) NUREG/CR-6823, Handbook of Parameter Estimation for Probabilistic Risk Assessment, USNRC, September 2003
- DA-D1 -- clarification
  - CC II and III
  - ...USE a Bayes update process ~~or equivalent statistical process that assigns that assigns appropriate weight to the statistical significance of the generic and plant specific evidence and provides an appropriate characterization of the uncertainty.~~ CHOOSE...
- DA-D6 -- clarification
  - Cat III:
  - USE realistic common cause failure probabilities....for significant common cause **basic** events. An example....
- DA-D8 -- **Qualification**
  - Cat I, II and III:
  - **For each SSC for which repair is to be modeled, ESTIMATE, based on the data collected in DA-C14, the probability of failure to repair the SSC in time to prevent core damage as a function of the accident sequence in which the SSC failure appears.**

Revisions to RG 1.200, Appendix A -- (Staff position on Chapter 4), cont'd

- IF-B1 – clarification
  - For each flood area....INCLUDE:
  - (a) equipment (e.g., piping, valves, pumps) located in the area that are connected to fluid systems (e.g., circulating water system, service water system,...**fire protection system**...
- IF-B3 -- clarification
  - (b) **range of** flow rate**s** of water
- IF-C1 -- clarification
  - For each defined flood area and each flood source, IDENTIFY the propagation path**s** from the flood source area to ~~its~~ **the** area**s** of accumulation.
- IF-C2c -- clarification
  - For each flood areas not screened out using the requirements under ~~other Internal Flooding supporting requirements (e.g.~~, IF-B1b ~~and IFC5)~~,...
- IF-C3 -- clarification
  - Cat I:
  - INCLUDE failure by submergence and spray in the identification process.
  - EITHER:
  - (a) ASSESS...by using conservative assumptions; OR
  - (b) NOTE that these mechanisms are not included in the scope of the evaluation.
  - **Cat II:**
  - **INCLUDE failure by submergence and spray in the identification process.**
  - **ASSESS qualitatively the impact of flood-induced mechanisms that are not formally addressed (e.g., using the mechanisms listed under Capability Category III of this requirement), by using conservative assumptions..**

Revisions to RG 1.200, Appendix A -- (Staff position on Chapter 4), cont'd

- IF-C3b – clarification
  - Cat II, III:
  - IDENTIFY inter-area...
  - INCLUDE potential for structural failure (e.g., of doors or walls) due to flooding loads **and the potential for barrier unavailability, including maintenance activities**.
- IF-D1 -- clarification
  - ...IDENTIFY the corresponding plant initiating event group identified per Table ~~4.5.7-1~~ **4.5.1-2(b)**.....
- IF-D3 -- clarification
  - Cat II:
  - ~~AVOID subsuming~~ **DO NOT SUBSUME** scenarios into a group...
- IF-E6a -- clarification
  - INCLUDE, in the quantification,....unavailability due to maintenance, **common-cause failures (adjusted, if necessary,** to account for the internal flooding modeling), and other credible causes.

Revisions to RG 1.200, Appendix A -- (Staff position on Chapter 4), cont'd

- 4.5.8.1 – clarification
  - The objectives of the quantification element are to provide an estimate of CDF **(and support the quantification of LERF)** based upon the plant-specific....
  - (b) significant contributors to CDF **(and LERF)** are identified such as initiating events....
- Table 4.5.8-1 HLR-QU-D -- clarification
  - ...significant contributors to CDF **(and LERF)**, such as initiating events, accident sequences.....
- QU-A2b -- clarification
  - ESTIMATE the mean CDF from internal events, accounting for the "state-of-knowledge" correlation between event probabilities ~~when significant~~ (see NOTE 1).
- Table 4.5.8-2(d)
  - ... significant contributors to CDF **(and LERF)**, such as initiating events, accident sequences ....
- QU-E4 -- clarification
  - Cat I:
  - PROVIDE an assessment of the impact of the key model uncertainties **and assumptions** on the results of the PRA.
- QU-F2 -- clarification
  - (g) **the significant basic events** ~~equipment or human actions that are the key factors in~~ causing the accidents **sequences** to be ~~non-dominant~~ **non-significant.**

Revisions to RG 1.200, Appendix A -- (Staff position on Chapter 4), cont'd

- LE-C1

Revisions to RG 1.200, Appendix B

- Revision to NEI-00-02 primarily addressed staff objections to Self-Assessment Process (Appendices D1 and D2)
- Staff objections in NEI-00-02, main body, Appendices A, B, and C remain
- Majority of objections in Appendices D1 and D2 have been removed

Revisions to RG 1.200, Appendix B (NEI Self-Assessment Actions)

- IE-A6 -- No objection with clarification
  - IE-16 does not address this issue.
  - Change as indicated since Addendum B incorporated previous NRC clarification (new Appendix A will not have this clarification). Added confirmation requirement, thus can delete documentation clarification
- HR-G2 – No objection with qualification
  - Self-assessment needs to document if both cognitive and execution errors are included in the evaluation of HEPs
- HR-G5 -- No objection with clarification
  - Evaluate proper inputs per the ASME standard or cite peer review F&Os **documentation/conclusions** or examples from your model.
- HR-G6 -- No objection with clarification
  - Check to ensure they are met by citing peer review F&O's **documentation/conclusions** or examples from your model.
- HR-H1 -- No objection with clarification
  - The self-assessment needs to confirm that the revised requirements in HR-H1 in Addendum A of the ASME Standard were addressed in the HRA. HR-21 is the applicable NEI 00-02 element.
- HR-H2 – No objection with qualification
  - The self-assessment needs to confirm that the revised requirements of HR-H2 in Addendum A of the ASME standard were included in the HRA.

Revisions to RG 1.200, Appendix B (NEI Self-Assessment Actions), cont'd

- DA-A3 -- No objection with qualification
  - The subject matter in DA-A3 is not explicitly addressed in NEI 00-002 (not a critical requirement since identification of the needed parameters would be a natural part of the data analysis)
- DA-C8 -- No objection with qualification
  - None of the cited NEI 00-02 elements is applicable.
- DA-D3 -- No objection with qualification
  - Verify that SR DA-D3 has been met. There is no qualification of DA-D3 in Reg Guide 1.200 Appendix A.
- DA-D6a -- No objection with qualification
  - Contrary to the NEI Self Assessment Action, this SR is required for a Category II PRA if the licensee performs screening of generic event data.

Revisions to RG 1.200, Appendix B (NEI Self-Assessment Actions), cont'd

- QU-C2 -- No objection with clarification
  - Verify that dependence between the HFEs in a cutset or sequence is assessed in accordance with ASME SRs HR-D5 and HR-G7.
- QU-E1 -- No objection with clarification
  - QU-30 does not provide guidance on sources of uncertainty
- QU-F2 -- No objection with qualification
  - Confirm availability of documentation. If not available, documentation may need to be generated to support particular applications or respond to NRC RAIs relative to applications. Self assessment also needs to confirm computer code has been sufficiently verified such that there is confidence in the results.

Revisions to SRP Chapter 19.1

Schedule

- Issue early August 2006 for 30 day public review and comment
- September 2006, brief ACRS
- October 2006, brief CRGR
- December 2006, issue for Revision 1 for use