

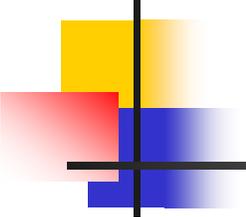
# Proposed Plan for Endorsement of PRA Standards and Related Guidance

(Completion of Plan on Phased Approach to PRA Quality)

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Mary Drouin, Office Nuclear Regulatory Research  
Donnie Harrison, Office of Reactor Regulation  
Lynn Mrowca, Office of New Reactors

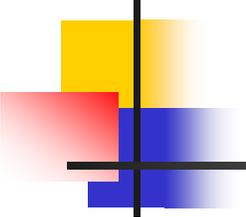
March 12, 2010



# Purpose of Meeting

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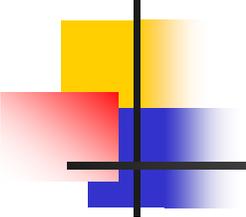
- To provide staff's understanding regarding the status on the probabilistic risk assessment (PRA) standards, associated peer review and other technical guidance
- To provide the staff's proposed path forward for endorsement of revised and new standards, associated peer review and other technical guidance in Regulatory Guide (RG) 1.200



# Topics to be Discussed

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- Background
  - Purpose and goal of standards and staff endorsement
  - PRA Infrastructure
  - Phased Approach to PRA Quality
  - Operating reactors – RG 1.200
  - New Reactors – RG 1.200
  - Risk Management
- Needed PRA infrastructure
- Status of PRA infrastructure
- Issues and Concerns
- Proposed path forward

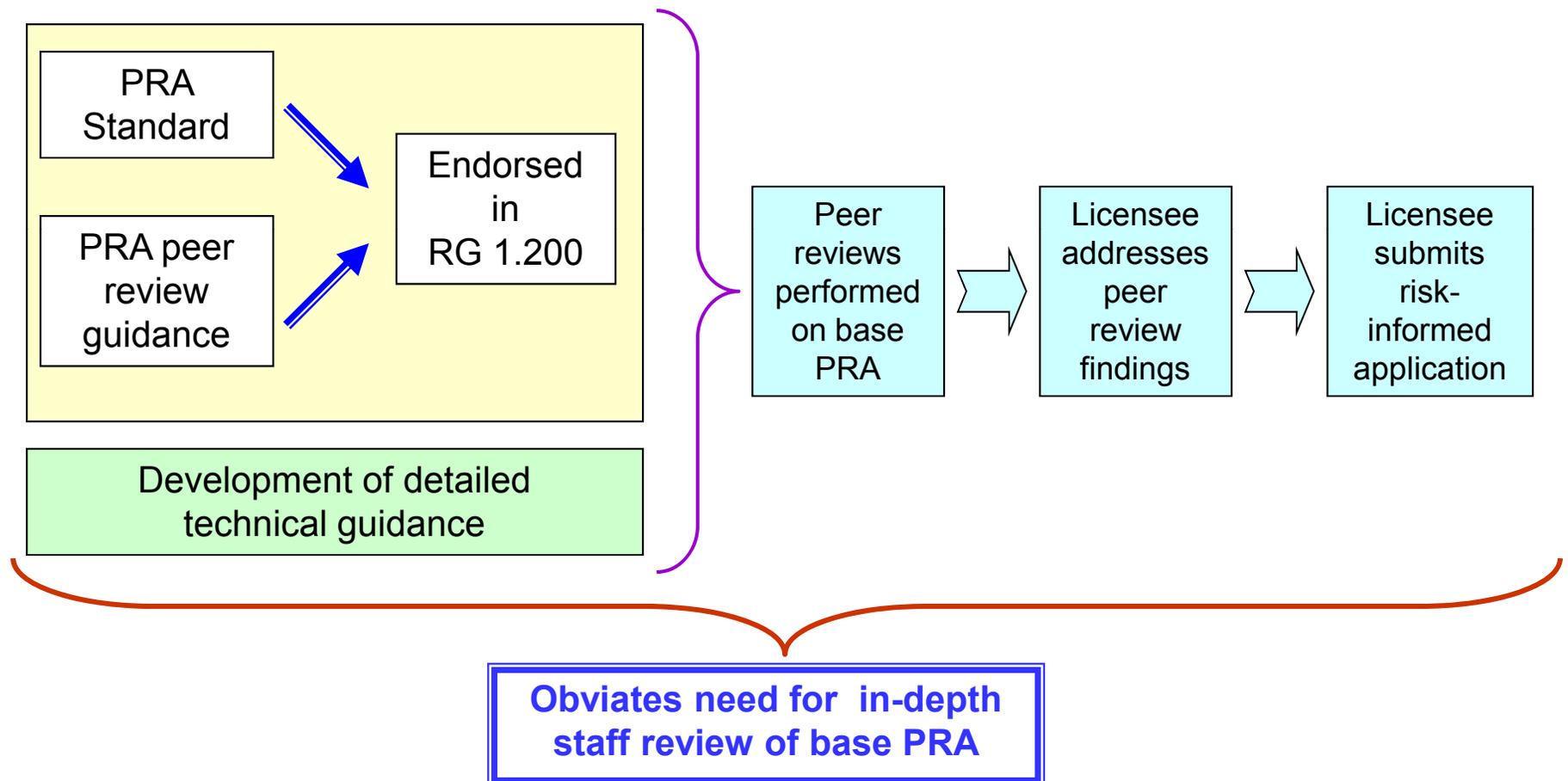


# PRA Quality

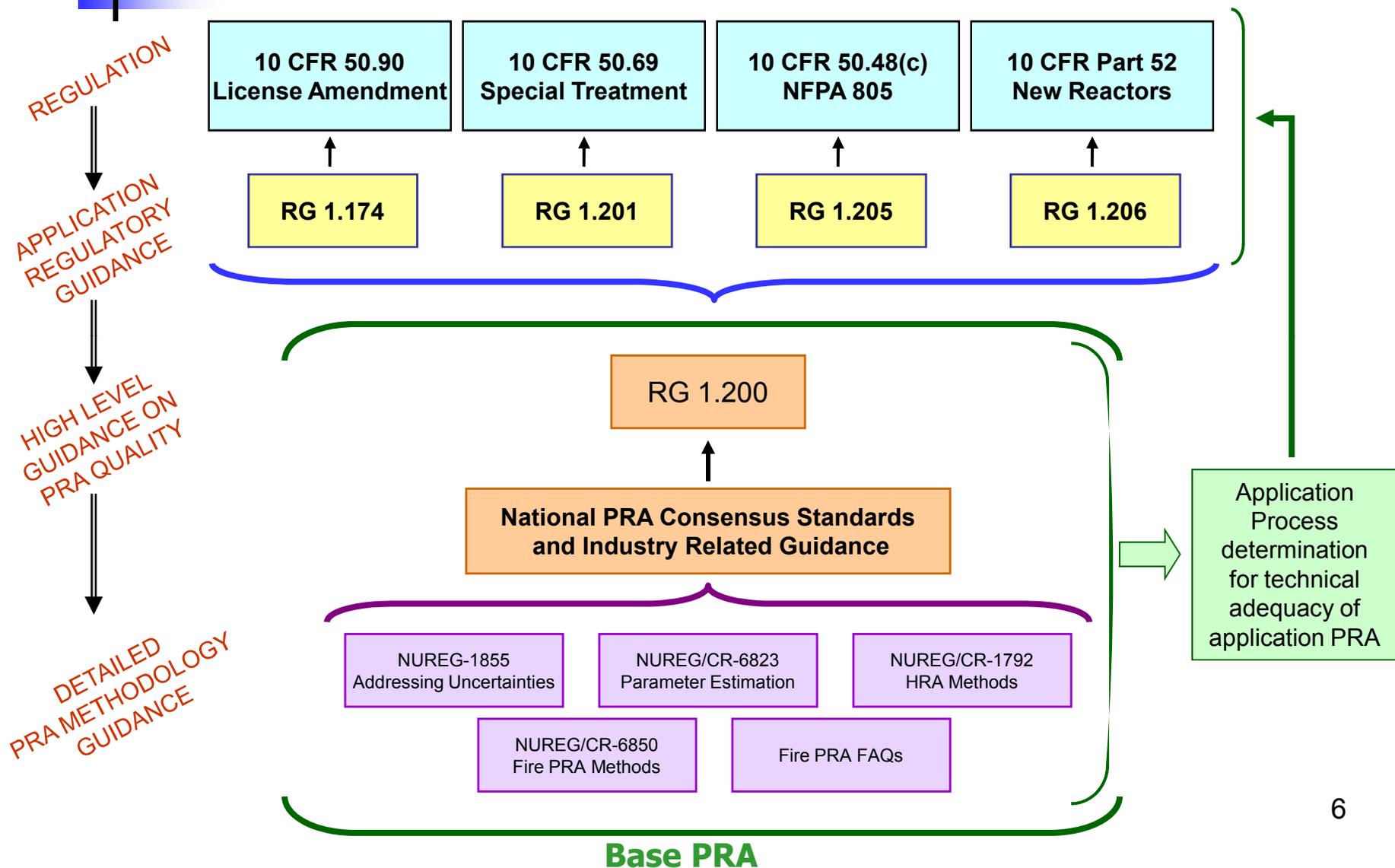
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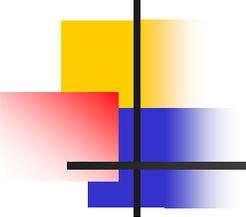
- PRAs used in support of risk-informed decision making have always had to be technically adequate to support the decision under consideration
- Prior to Regulatory Guide (RG) 1.200 and the PRA Standard, understanding of technical adequacy was ambiguous and inconsistent
- RG 1.200 and the PRA standard have only formalized the process
- Benefits in formalizing process
  - Obviate need for staff review
  - Stability and predictability

# Goal of Standards, Peer Review, RG 1.200



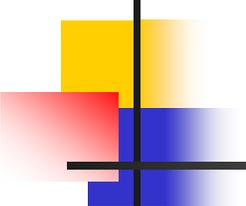
# PRA Quality Infrastructure





# NRC Plan on Phased Approach to PRA Quality for **Operating** Reactors

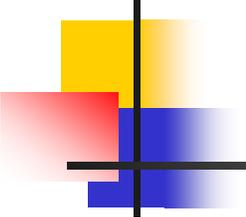
- Plan recognized that the needed “PRA infrastructure”(e.g., PRA standard) to support the various risk-informed activities was not completed
- The Phased Approach Plan to PRA Quality enabled progress to be made in risk-informed activities while the necessary infrastructure (e.g., development of PRA standards and related industry guidance) was being built
  - Plan provided to Commission in SECY-04-0118 and approved in Commission SRM, October 6, 2004
- Plan involved:
  - Identification of risk-informed activities and associated needed guidance for PRA technical adequacy
  - Identification, development and endorsement of needed standards and related guidance



# Regulatory Guide 1.200

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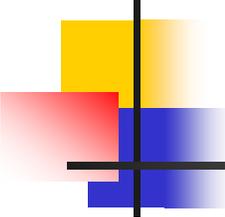
- NRC issued Regulatory Issue Summary (RIS) 2007-06, *Regulatory Guide 1.200 Implementation*
  - Implementation period of one year allowed for limited-scope applications
- RG 1.200, Revision 1 issued January 2007
  - Provides NRC endorsement, with objections, of
    - ASME RA-Sb-2005, *Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications* (at-power conditions for internal events and internal floods)
    - NEI Peer Review Guidance NEI 00-02 (Internal Events and Internal Flood)
  - Effective implementation date of January 2008
- RG 1.200, Revision 2 issued March 2009
  - Provides NRC endorsement, with objections, of
    - ASME/ANS RA-Sa-2009, *Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications* (at-power conditions for internal and external hazards)
    - NEI Peer Review Guidance NEI 00-02 (Internal Events and Internal Flood)
  - Effective implementation date of April 2010
    - Only the “delta” between Revision 1 and Revision 2 needs implementation



# RG 1.200, Revision 2

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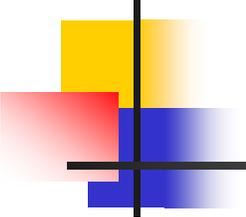
- Based on Commission October 6, 2004 SRM to SECY-04-0118 and RIS 2007-06, all risk-informed applications are expected to conform with ASME/ANS RA-Sb-2009, as endorsed by RG 1.200, Revision 2, as appropriate for the application
  - All significant contributors to the decision (either important to the delta or total risk calculation) are expected to be evaluated using appropriate PRA methods conforming with the NRC-endorsed PRA standards
  - Valid bounding approaches can be used to address the risk contributors not modeled in the licensee's PRA analyses
  - Licensees may be able to reduce or limit the scope of their requested licensing action to reduce the significance of specific contributors so that the licensee's PRA is adequate for the application
  - Licensee-proposed compensatory measures and actions can be used to address uncertainties and limitations in the PRA modeling, but cannot be used as a substitute for modeling in the PRA the contributors that are significant to the risk-informed decision
  - The staff plans to propose rejection of risk-informed applications not consistent with the above expectations



# RG 1.200 Activities – Operating Reactors

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- All PRAs supporting risk-informed activities are expected to be technically adequate
- Not every regulatory risk-informed activity is explicitly reviewed against RG 1.200
- Staff and licensees need to have a common understanding of those risk-informed activities expected to be explicitly reviewed against RG 1.200
- Those risk-informed activities expected to be explicitly reviewed against RG 1.200 are those activities where
  - the licensee's PRA results and insights are significant to the regulatory activity and
  - the staff would normally perform an in-depth review of the base PRA

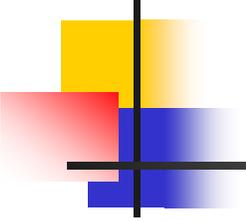


# Risk-informed Activities Not Reviewed Against RG 1.200

(Operating Reactors)

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- NRC Component Design Bases Inspection
- NRC Component Risk Ranking
- NRC Management Directive 8.3
- Mitigating System Performance Indicator
- Notice of Enforcement Discretion
- Severe Accident Mitigation Alternatives
- Significance Determination Process
- §50.65 Requirements for monitoring the effectiveness of maintenance at nuclear power plants



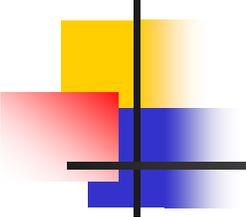
# Risk-informed Activities

## Reviewed Against RG 1.200

(Operating Reactors)

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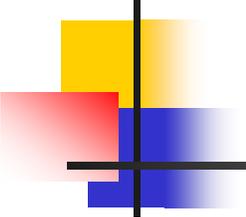
- §50.48 (c) National Fire Protection Association Standard NFPA 805
- RG 1.174, 1.175, 1.177, 1.178
- Technical Specifications 4b and 5b
- §50.69 Risk-informed categorization and treatment of structures, systems and components for nuclear power reactors



# For Operating Reactors, Scope of PRA Needed for Application

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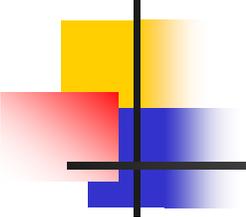
- Licensee defines the needed scope when defining the scope of their application
  - The extent to which a licensee's PRA needs to be in conformance with the PRA Standard (as endorsed in RG 1.200) is completely dependent on the scope of the application
- A "full-scope" Level 1/LERF PRA provides maximum benefit
- There are some applications where a full Level 2 or Level 3 would be beneficial



# PRA Technical Adequacy for New Reactors

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- For new reactors, required to have
  - Level 1 and Level 2 PRA for DC and COL per §52.47 and §52.79, respectively
  - Per §50.71(h)(1), Level 1 and Level 2 PRA no later than the scheduled date for initial loading of fuel, each holder of a combined license under subpart C of 10 CFR Part 52
    - The PRA must cover those initiating events and modes for which NRC-endorsed consensus standards on PRA exist one year prior to the scheduled date for initial loading of fuel
- RG 1.200 also addresses new reactors

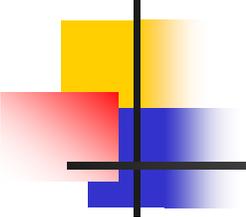


# RG 1.200 for New Reactors

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- PRAs developed as part of either obtaining DC or COL (as required by 52.47 and 52.79, respectively) are RG 1.200 applications, as applicable\*
- PRAs used to support a regulatory risk-informed application, prior to operation, are expected to meet RG 1.200, as applicable\*
- Risk-informed applications (e.g., licensing changes) for new reactors are expected to meet RG 1.200
  - The extent to which standards have to be met (risk contributors) will be defined by the application

\* It is understood that until the revision of RG 1.200 is issued which will endorse PRA standard for new reactors, there are some limitations in meeting Revision 2 of RG 1.200 for new reactors



# RG 1.200 for New Reactors

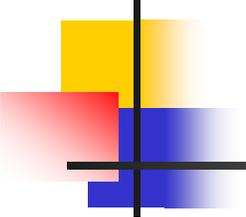
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- Expectations for new reactors same as for operating reactors:
  - Obviate the need for an in-depth staff review of the base PRA
  - Allow staff to focus on key assumptions and areas identified by peer reviewers as being of concern
  - Provide for a more focused and consistent review process by the staff
- Standards required for PRA
  - Design and construction stage
  - At initial fuel loading
  - Early operational stage (after fuel loading)
- Standards needs to be of sufficient specificity to support the above goals
  - Remove ambiguity with regard to the technical requirements for a PRA in design/construction and early operational stages
  - Parameters for acceptable assumptions for information not available for a PRA in design/construction and early operational stages

# Summary of Risk-Informed Regulatory Activities and PRA Needs

Activity	RG 1.200		Level 1/LERF				LPSD			Level 2		Level 3
	yes	no	Int	Fld	Fire	Ex	Int/FI	Fire	Ex	Pwr	LPSD	
CDBI		√										
Comp Risk Ranking		√										
MD 8.3		√										
MSPI		√										
50.48 (c)	√		√	E	√	E	E	E	E			
NOED		√	E	E	E	E	E	E	E			
RG 1.174	√		√	E	E	E	E	E	E			
RG 1.175	√		√	E	E	E						
RG 1.177	√		√	E	E	E						
RG 1.178	√		√	E	E	E						
SAMA		√	E	E	E	E	E	E	E	E	E	E
SDP		√										
Tech Spec 4b (AOT)	√		√	E	E	E	E	E	E			
Tech Spec 5b (STI)	√		√	E	E	E	E	E	E			
50.65 (a)(2)		√										
50.65 (a)(4)		√	E	E	E	E	E	E	E			
50.69	√		√	E	E	E	E	E	E			
50.71, 52.47, 52.79 (new reactors)	√		√	√	√	√	√	√	√	√	√	

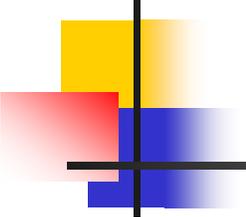
⇒ *All applications for operating reactors are to include an internal events, at-power PRA; other contributors modeled will Enhance the scope of the application.* 17



# “Risk Management”

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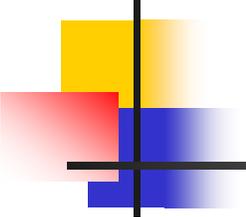
- Risk management and PRA are NOT the same, the terms can not be used interchangeably
- Risk management is a process and discipline
- PRA is an analysis, one of many used to support risk management
- Tentative definition proposed by ASME:
  - *Risk Management is a formal process to identify, analyze, and evaluate the sources of risk and then make appropriate decisions to achieve or maintain an acceptable risk level at an acceptable cost.*
    - *The insights obtained from an evaluation of the risk and identification of the major contributors to risk are used to decide whether to accept, avoid or mitigate the risk*
    - *Acceptable levels of risk and costs may be driven by internal factors, e.g., owner cost-benefit, or external factors, e.g., regulatory goals, public perception*
- Risk management has been occurring, should formalize in a consensus standard to achieve a common understanding among stakeholders



# Risk Management Standard

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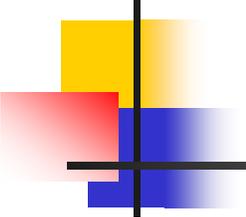
- An “over-arching” standard that defines what is meant by risk management and establishes the process for achieving risk management
- Standard should
  - Define a process for identifying and developing risk-informed activities
    - Both regulatory- and utility-driven type of activities
  - Identify the different types of technical bases needed to support the various risk-informed activities, for example,
    - PRA technical adequacy
    - Peer review
    - Qualitative bounding analyses
    - Risk monitoring (i.e., Element 5 of Risk-Informed Decision Making as discussed, for example, in RG 1.174)
  - Identify the optimum mechanisms for addressing/developing the technical bases, for example,
    - Standards
    - Regulatory guides
    - Technical guidance documents
    - Training



# Risk Management Technical Bases

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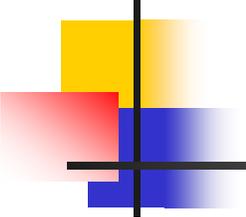
- Technical bases for risk management can be classified as either
  - PRA infrastructure – technical bases supporting establishment of PRA technical adequacy, or
  - Non-PRA – technical bases addressing risk but using approaches that are not PRA
- There are two levels defining the PRA infrastructure
  - PRA standard which establishes *what is* a technically adequate PRA
  - Technical guidance documents which establish *how to* develop a technically adequate PRA model
- Technical guidance is equally important as development of PRA standard, NRC examples
  - NUREG-1855 – Treatment of Uncertainties
  - NUREG/CR-6850 – Fire PRA Methodology
  - NUREG-1921 – Fire HRA
  - NUREG-1792 – HRA Good Practices
  - NUREG-1842 – Evaluation of HRA Methods
  - NUREG/CR-6595 – Simplified Containment Event Trees
  - NUREG/CR-6823 – Parameter Estimation Handbook
- Other technical guidance needed?
- Status of PRA Standard; e.g., what remains and how to complete?



# PRA Infrastructure to Support Risk-Informed Applications – 3 Parts

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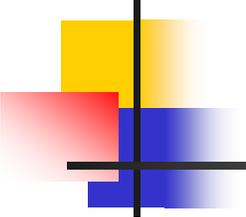
1. Technical guidance defining technical adequacy of base PRA model
  - Standard establishing technical requirements defining what the PRA model is to contain
  - Technical guidance providing methodology on how to meet the requirements of the standard
2. Peer review guidance
  - Requirements of process, team, etc.
  - Detailed guidance on process addressing each risk contributor
3. Application process guidance
  - Requirements to determine scope and level of detail needed (and therefore the applicable technical requirements) for the application



# Status of Standards – Level 1/LERF

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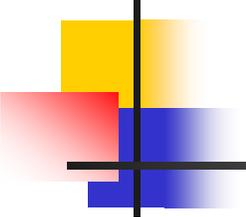
- Level 1/LERF (ASME/ANS RA-Sa-2009) – at-power, ***operating reactors***
  - Internal and external hazards
  - Published and endorsed
  - Outstanding internal fire and seismic issues
- Level 1/LERF (To be part of ASME/ANS RA-Sa-2009) – low power shutdown, ***operating reactors***
  - In consensus process
    - Ready to ballot, previous ballots failed
  - Does not address internal fire
  - Includes requirements for LPSD plant configuration control
- Level 1/LERF (to be part of ASME/ANS RA-Sa-2009) – ***new reactors***
  - Preliminary draft
  - Initial standard addresses internal events, at-power, Level 1/LERF
  - Pre-operational



# Status of Standards – Level 2 and Level 3

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- Level 2 (ANS/ASME 53.xx)
  - Applicable for operating and new reactors
  - Does not address internal floods, internal fires or external hazards
  - Does not address LPSD
  - Preliminary draft complete, ready to start consensus process
- Level 3 (ANS/ASME 53.xx)
  - Applicable for operating and new reactors, all hazards, all plant conditions
  - Preliminary draft complete, ready to start consensus process

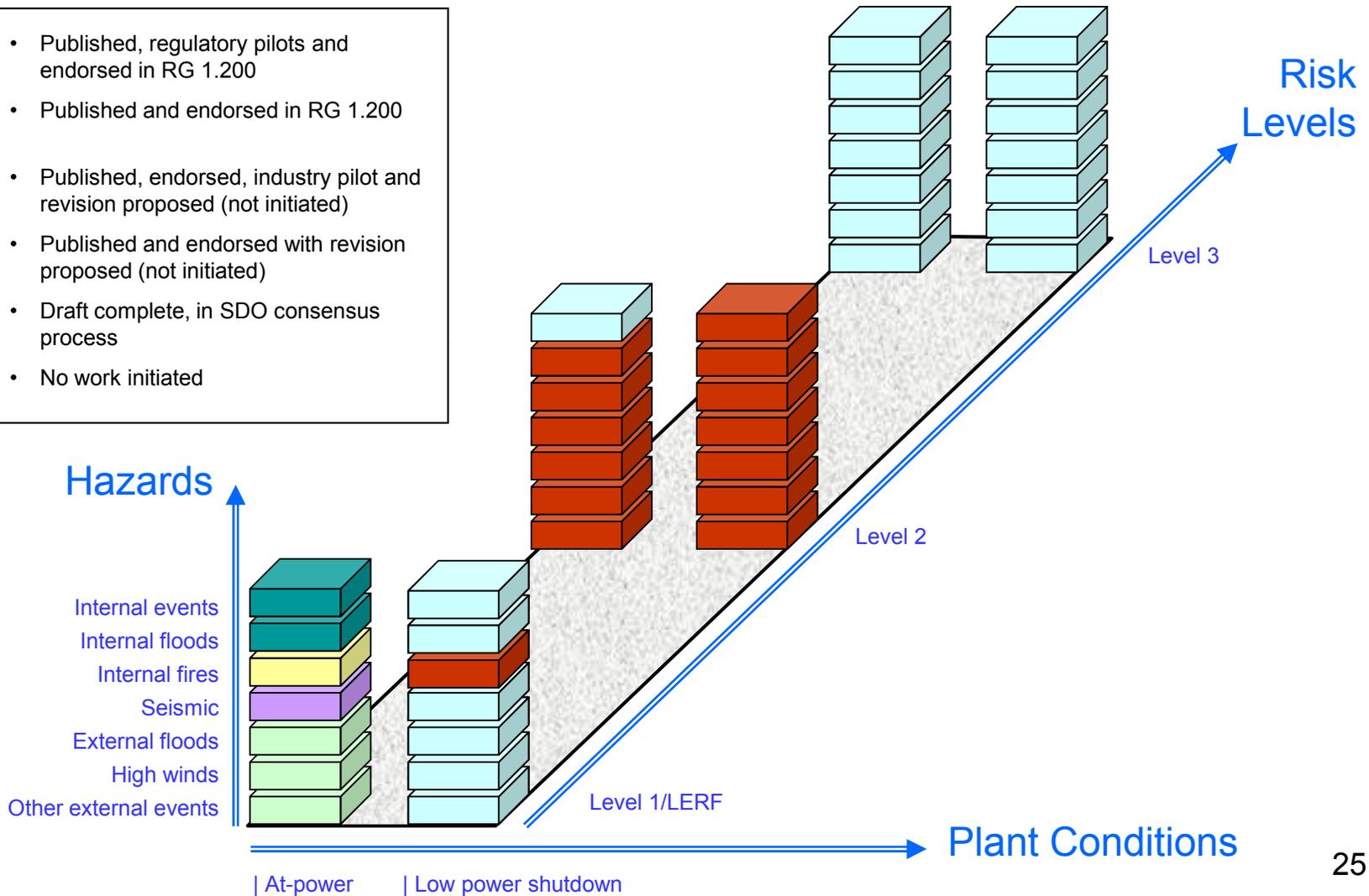
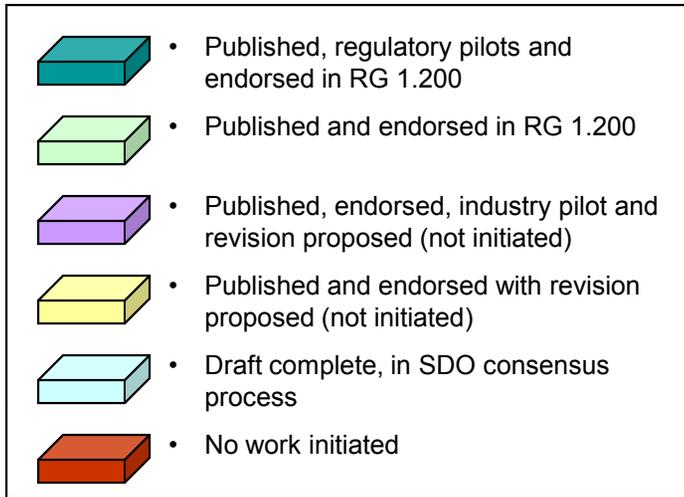


# Status of Peer Review Guidance

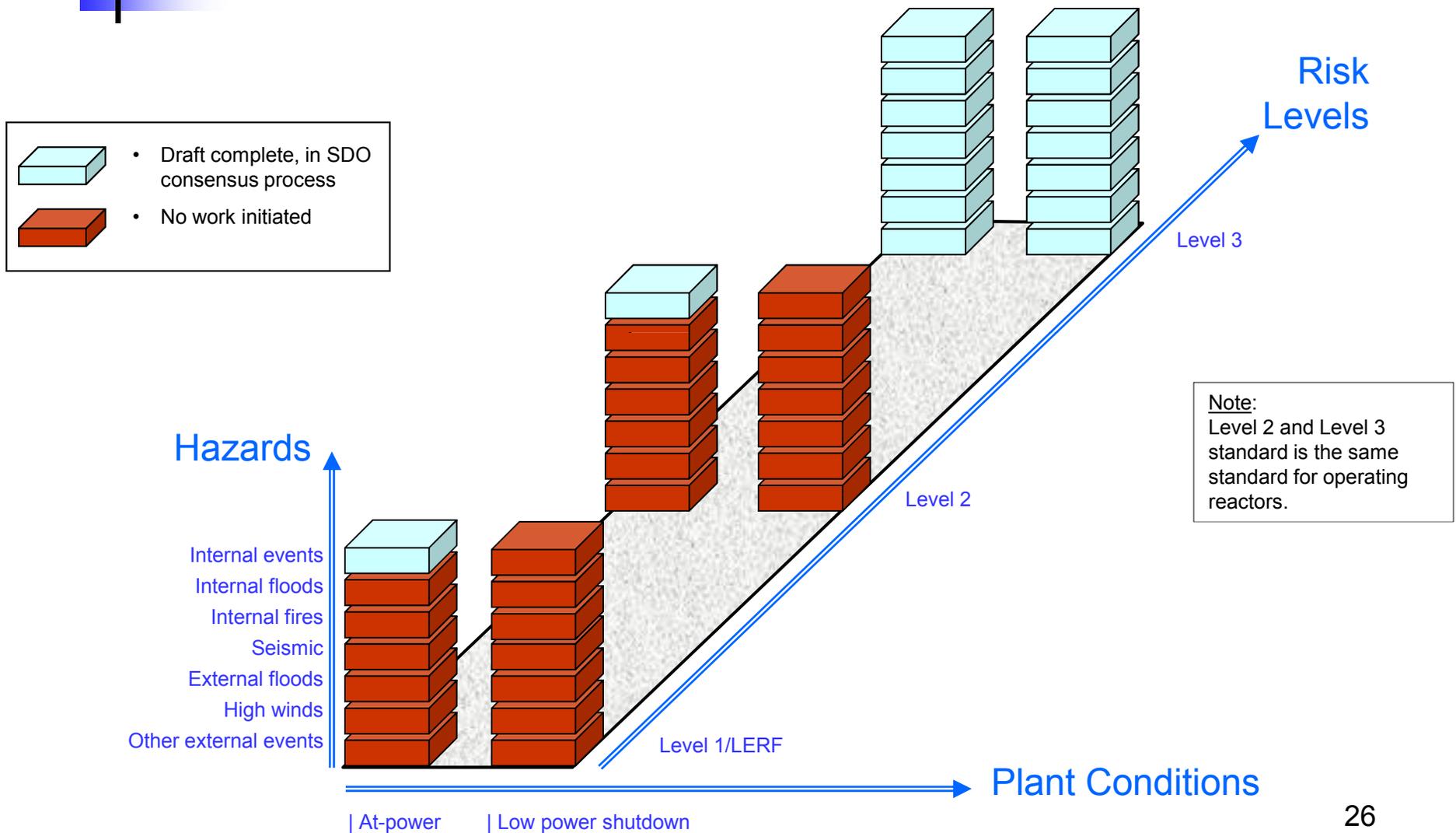
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- NEI 00-02: Level 1/LERF – at-power, operating plants
  - Internal events and internal flood
  - Published and endorsed
  - No outstanding issues
- NEI 05-04 – PRA Update
  - At-power
  - Issue: applicability beyond Level 1/LERF
- NEI 07-12: Level 1/LERF – at-power, internal fire, operating plants
  - Published and endorsed
  - Outstanding issues (e.g., FAQs)
  - Unclear if revision planned and scheduled
- Level 1/LERF – new reactors
  - Unclear regarding plans to develop by SDO or industry
- Level 2
  - Unclear regarding plans to develop by SDO or industry
- Level 3
  - Unclear regarding plans to develop by SDO or industry

# Status of Standards for Operating Reactors

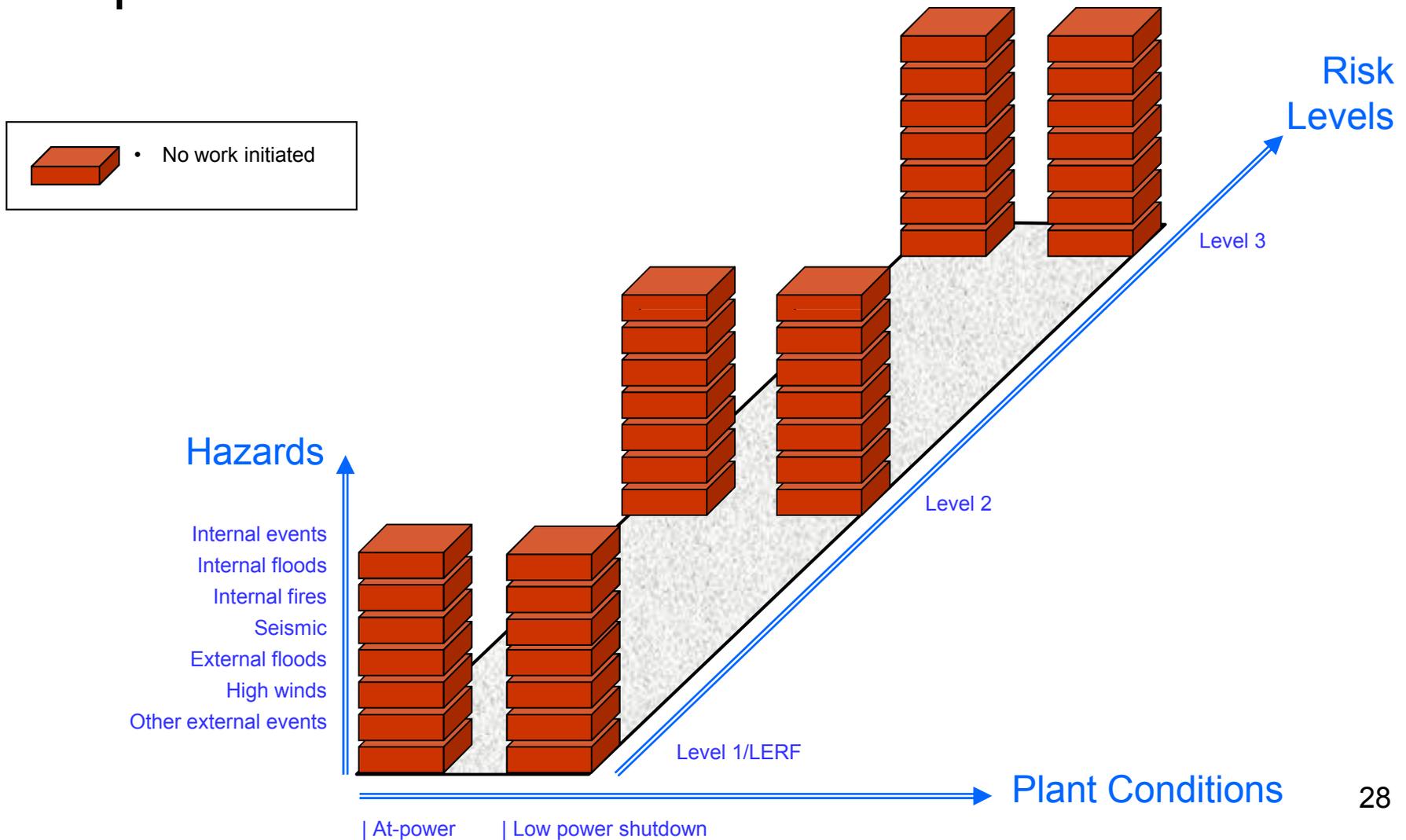


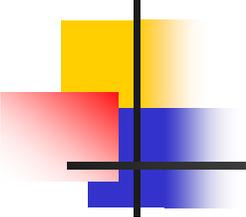
# Status of Standards for New Reactors





# Status of Peer Review Guidance for New Reactors

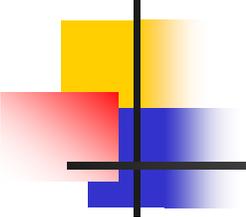




# Issues/Concerns

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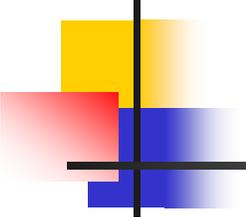
- Schedule for revising current standards for fire and seismic
- Schedule for issuing remaining (new) standards
- Schedule for revising current peer review guidance and issuing additional guidance for outstanding standards
- Approach for addressing PRA technical adequacy for new reactors appears to support staff needs
- Date for next revision to RG 1.200
  - Multiple RG 1.200 revisions to endorse each standard revision or single RG 1.200 revision endorsing after standard revision and new standards



# Issues/Concerns (cont'd)

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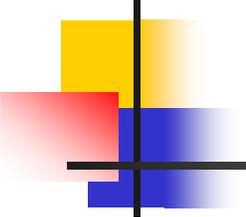
- Pilots
  - Pilots on Level 1/LERF internal events at-power PRA standard were performed under RG 1.200 (trial use) as part of regulatory application – very successful in finalizing both the RG and the standard
  - Pilot the standard independent of regulatory application?
  - Should all remaining parts of the standard be piloted?
- ANS standard has requirements for both a LPSD PRA and for plant configuration control during LPSD
  - ASME/ANS Level 1/LERF PRA standard is a standard that “sets forth the requirements for PRAs used to support risk-informed decisions for commercial light water reactor nuclear power plants”
  - Have requirements for plant configuration control is inconsistent with the stated objective of the standard
  - While useful for licensees in supporting their internal risk management activities, is not a LPSD PRA standard, and should be in its own standard or related risk management standard
    - Publish LPSD PRA standard as part of the ASME/ANS Level 1/LERF PRA Standard, and publish LPSD Configuration Control as part of a risk management standard



# Proposed Path Forward

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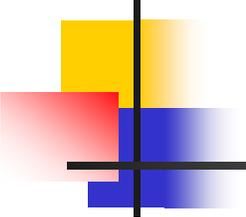
- Focus near term activities on addressing fire and seismic issues
- For longer term activities, development, publication, and endorsement of standards would be centered around pilot applications
- Proposed pilot applications would use pilot model similar to that used for the Level 1/LERF ASME PRA original standard
- Pilot model:
  - Standard is issued
  - Staff reviews standard for initial, preliminary endorsement in draft guide for trial use as part of public review and comment period
  - Staff request for fee waiver
  - Applications submitted as part of pilot (during the public review and comment period)
  - Pilots performed
  - Standard revised based on lessons learned from the pilots
  - Regulatory guide revised based on lessons learned and revised standard and other public comments and issued for use
  - Implementation “clock” would not commence until after the pilots and final endorsement when regulatory guide issued for use



# Proposed Plan – Four “Stages”

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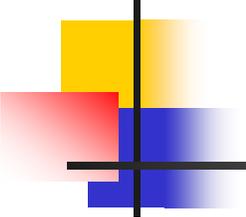
- Stage 1:
  - SDO issue standards:
    - Revise ASME/ANS Level 1/LERF standard to address outstanding issues with internal fire and seismic and to address LPSD PRA, and PRA for new reactors
    - Level 2 and Level 3 standards
  - Issue peer review guidance on outstanding scope items and revise others as necessary
    - As different scope parts of standards were combined into single joint standard, similar path should be pursued with peer review guidance
      - ***Staff proposing to develop and issue a single peer review process that addresses all scope items***
  - Develop pilot plan (e.g., identify pilot applications) working with industry



# Proposed Plan – Four “Stages” (cont’d)

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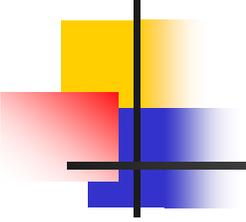
- Stage 2:
  - NRC issues separate DGs for public review and comment
    - First DG (DG-xxxx) with a short comment period for final endorsement of revised standards and peer review guidance
    - Second DG (DG-yyyy) with a long comment period for *preliminary* endorsement of new standards and peer review guidance for trial use and pilot applications
  - Pilots applications performed using DG-yyyy and new standards
    - Task includes developing lessons learned from the pilots
  - Revise new standards based on lessons learned from the pilots
  - Short term review and comment period closes for DG-xxxx
    - Issue Revision 3 to RG 1.200 to endorse revised standard addressing fire and seismic



# Proposed Plan – Four “Stages” (cont’d)

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- Stage 3:
  - Long term public review and comment period closes for DG-yyyy for staff endorsement of new standards
    - Staff revises DG-yyyy based on
      - Public comments
      - Revised standards
      - Lessons learned from pilots
    - Revision 4 of RG 1.200 issued for use
  - Implementation of Revision 3 of RG 1.200
    - Operating reactors, licensees expected to meet Revision 3 one year after publication

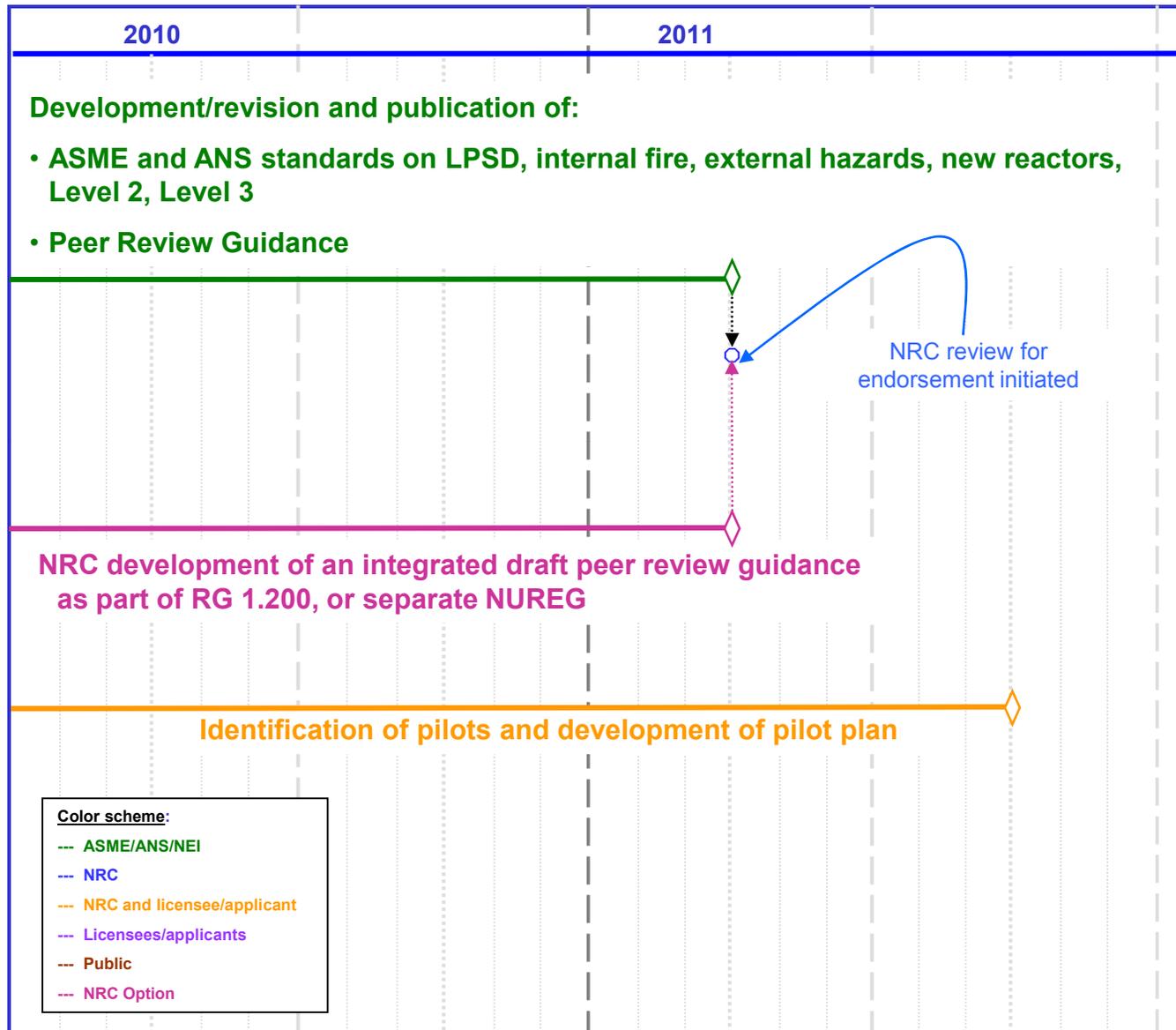


## Proposed Plan – Four “Stages” (cont’d)

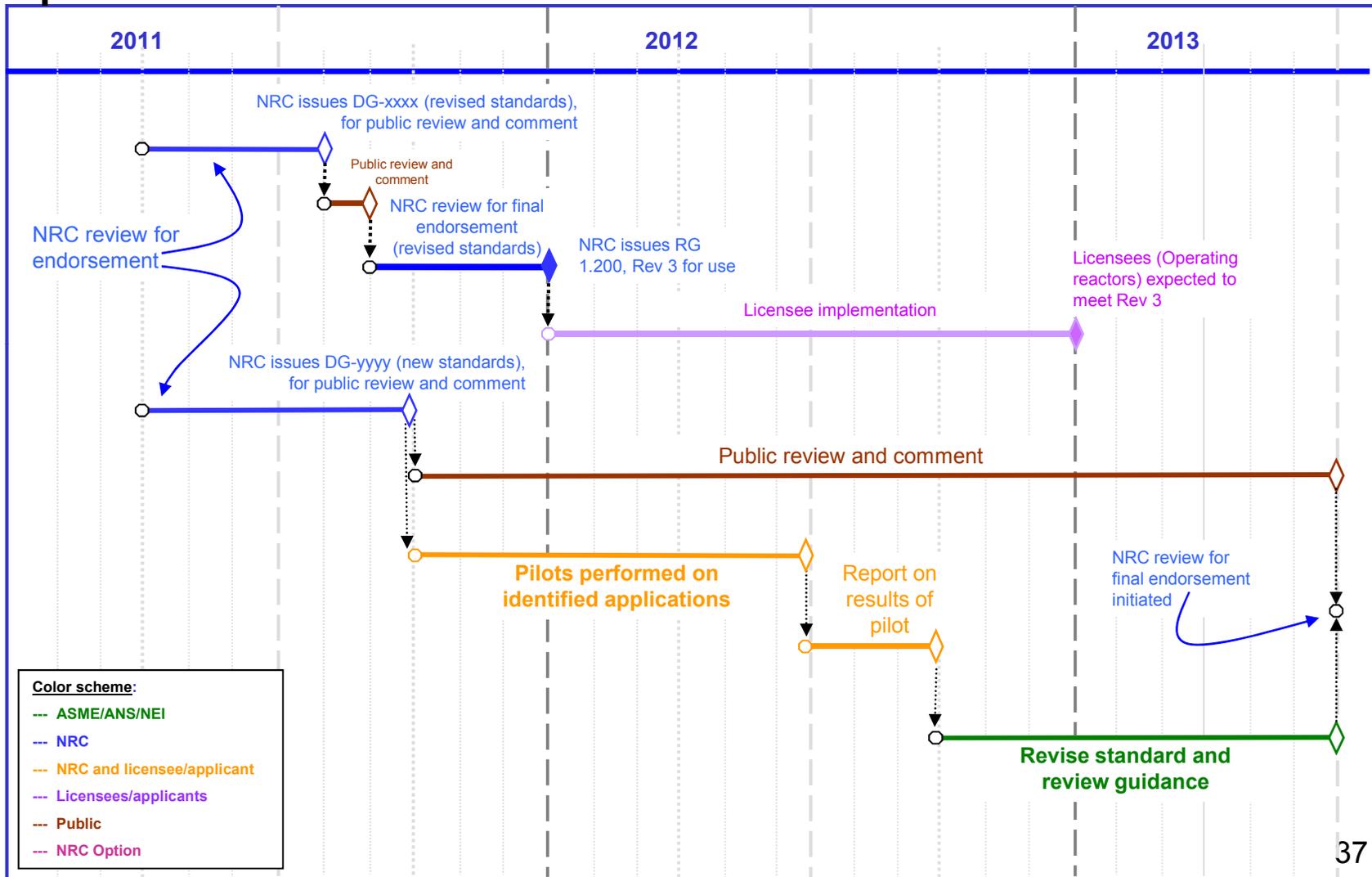
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- Stage 4:
  - Implementation of Revision 4 of RG 1.200
  - Commence updating PRA during the 2 year pilot period
  - New Reactors, since fuel loading for any reactor not expected until 2016, PRA is to meet NRC endorsed standard (i.e., RG 1.200, Rev 4)

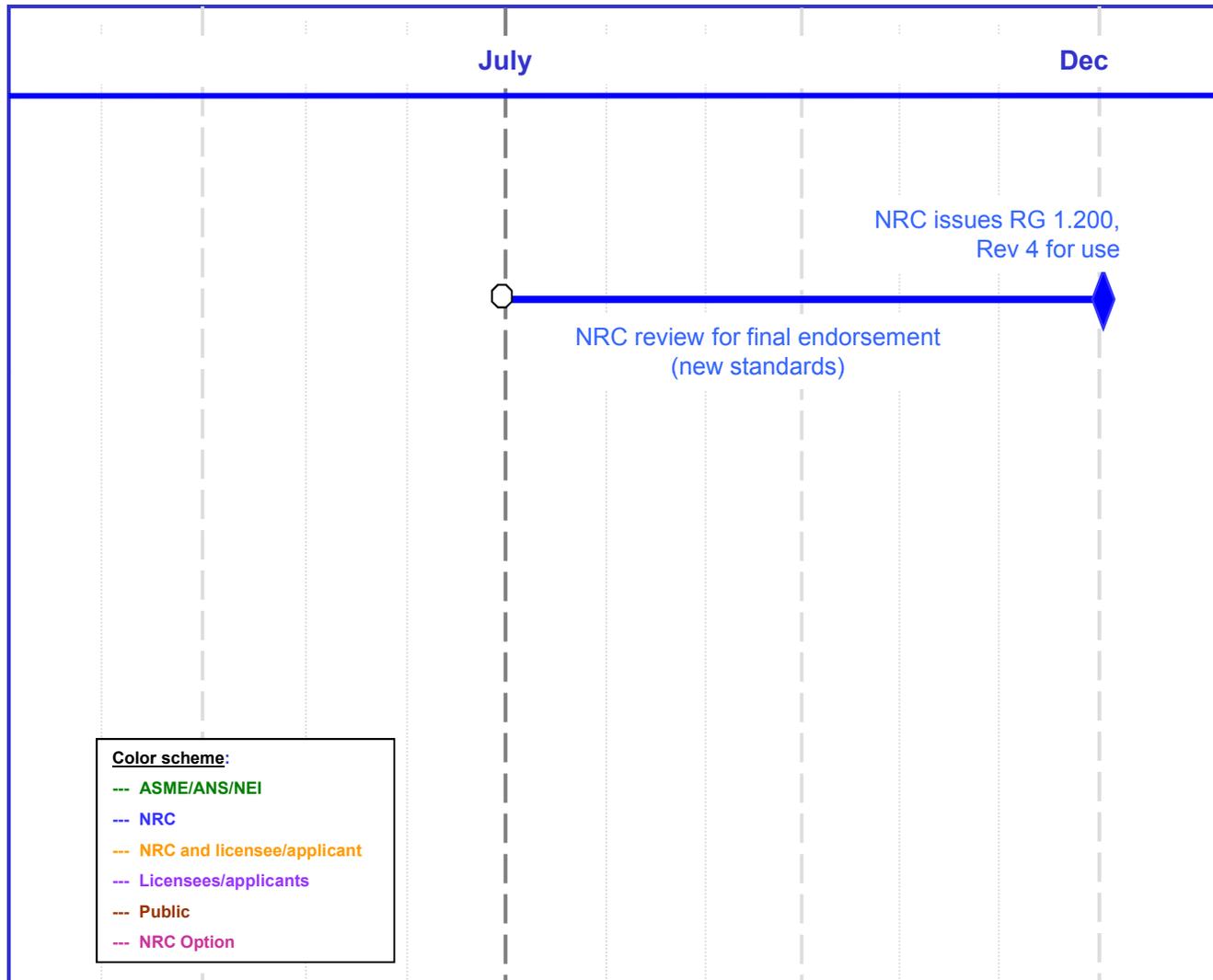
# Stage 1: Milestones and Schedule



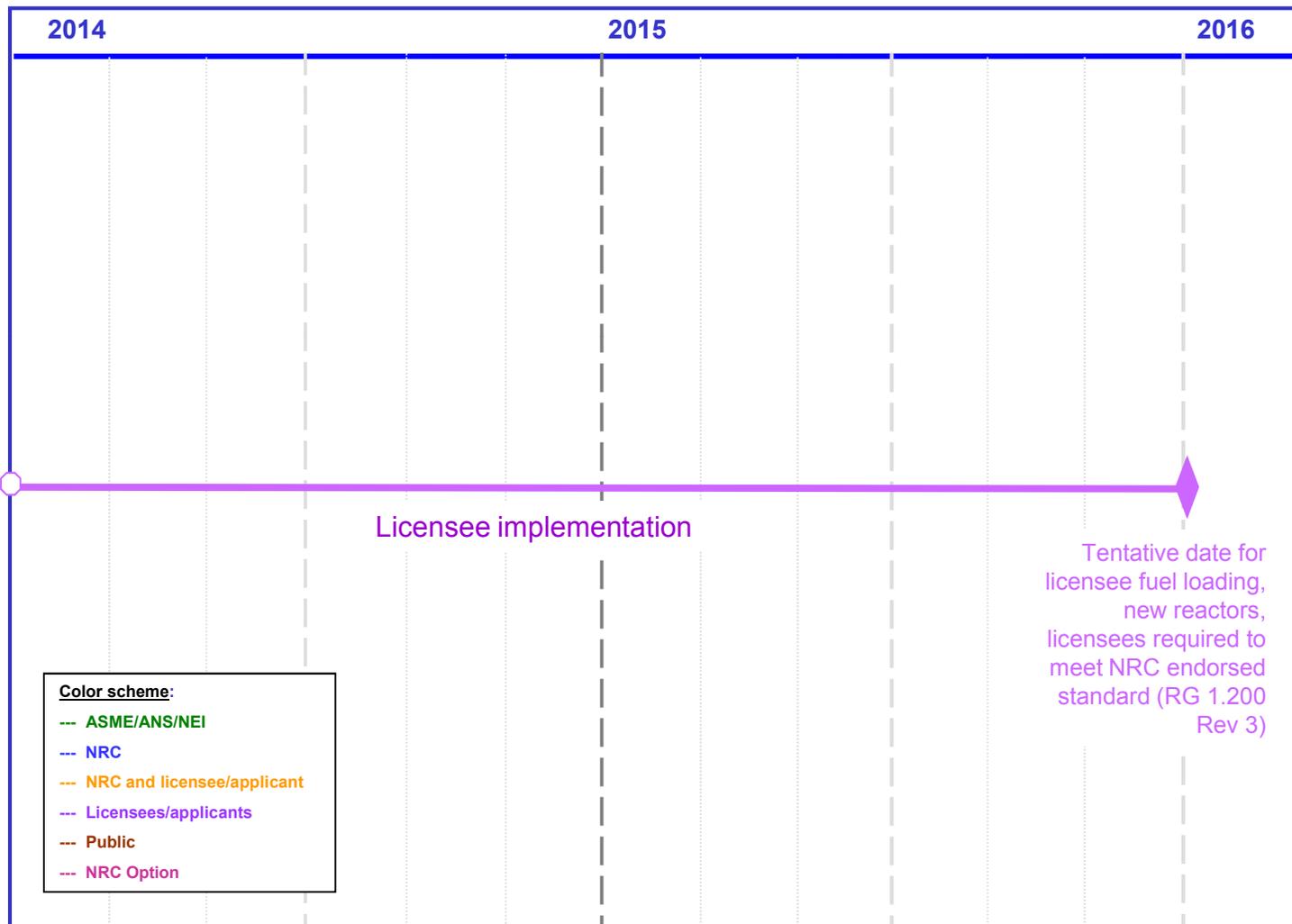
# Stage 2: Milestones and Schedule



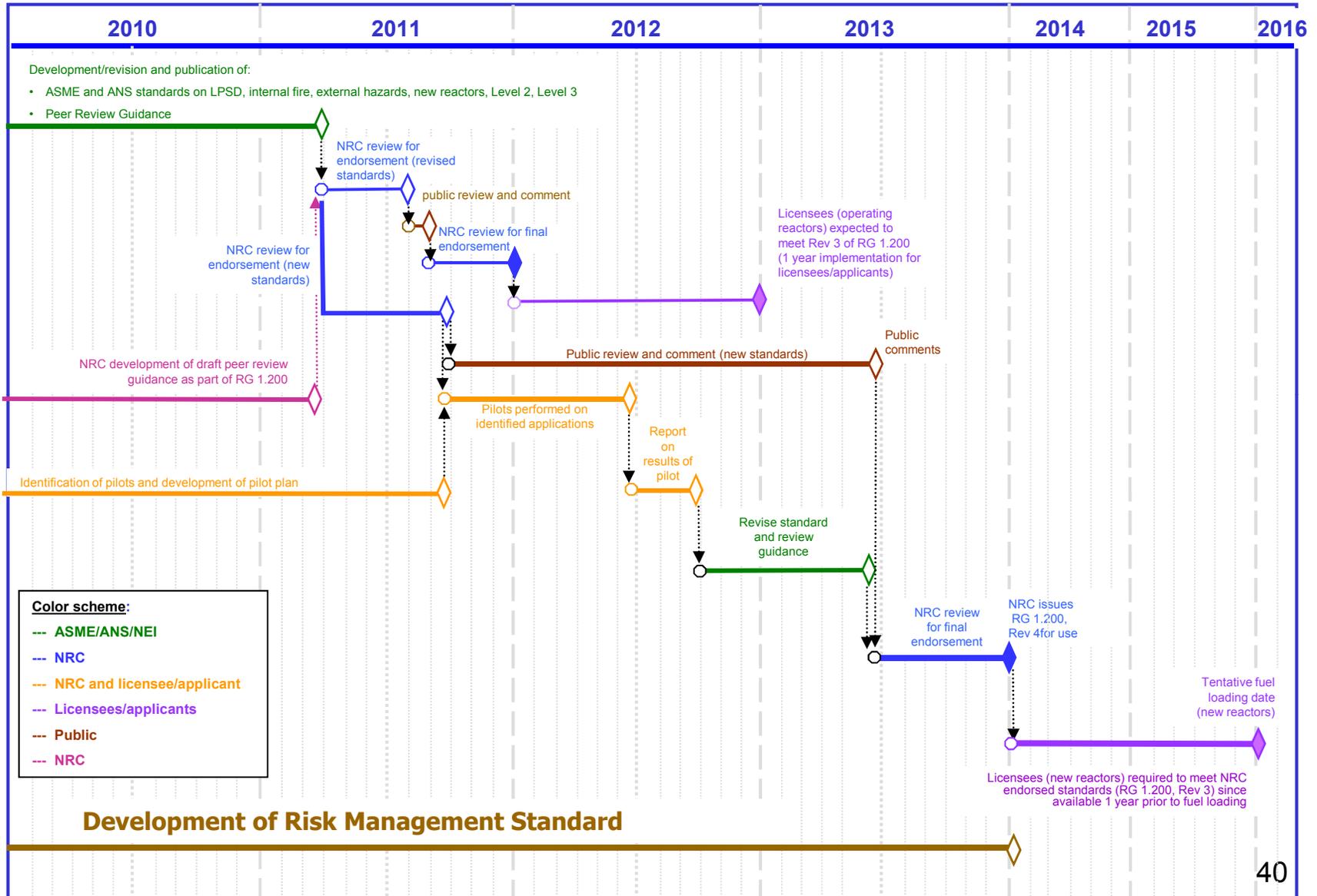
# Stage 3: Milestones and Schedule -- 2013

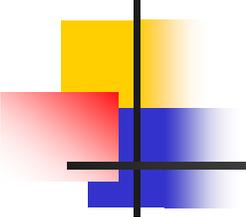


# Stage 4: Milestones and Schedule



# Milestones and Schedule -- Summary





# In Conclusion . . . .

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- Do not delay revising PRA standards for fire and seismic for staff review and endorsement, and staff will expedite revision to RG 1.200
- Do not delay issuing remaining PRA standards; that is, resolve outstanding issues during pilot process
- Work with industry in developing pilot plan to test new standards
- Final NRC endorsement, for new standards, after completion of pilots and standards revised
- Identify where additional technical guidance is needed
- Work with industry in development of a single, integrated peer review guidance addressing all hazards, plant operating mode for both operating and new reactors
- Staff supports the concept of developing and publishing a “risk management” standard that identifies and brings together associated related standards and guidance
- Work closely with industry in achieving alignment with the staff’s proposed plan