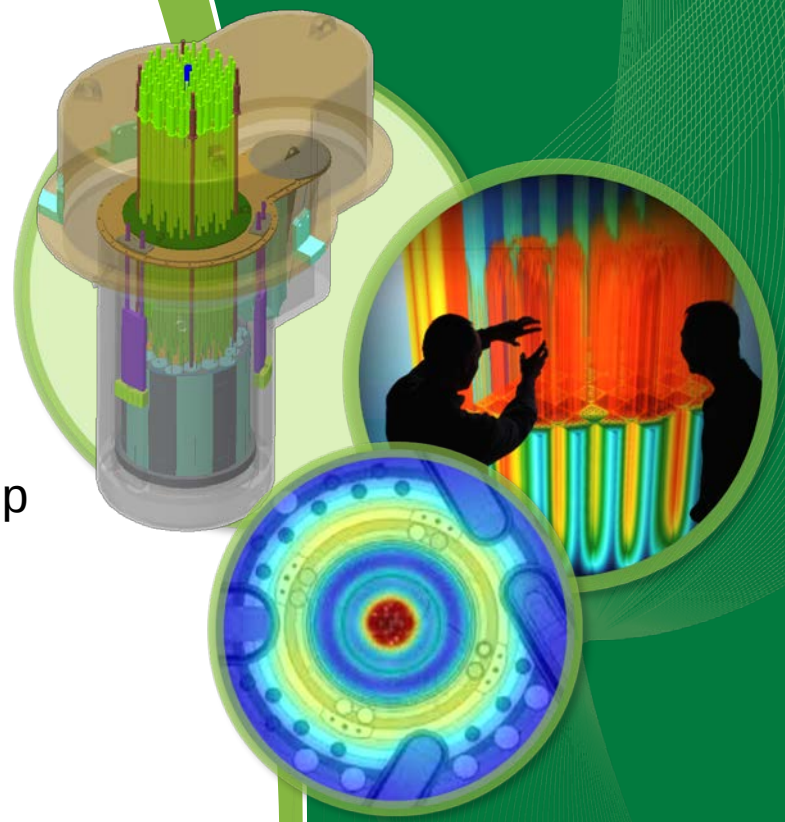
Summary of Analysis of Consensus Standards for Advanced Reactors



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Molten Salt Reactor Workshop 2017

October 3, 2017

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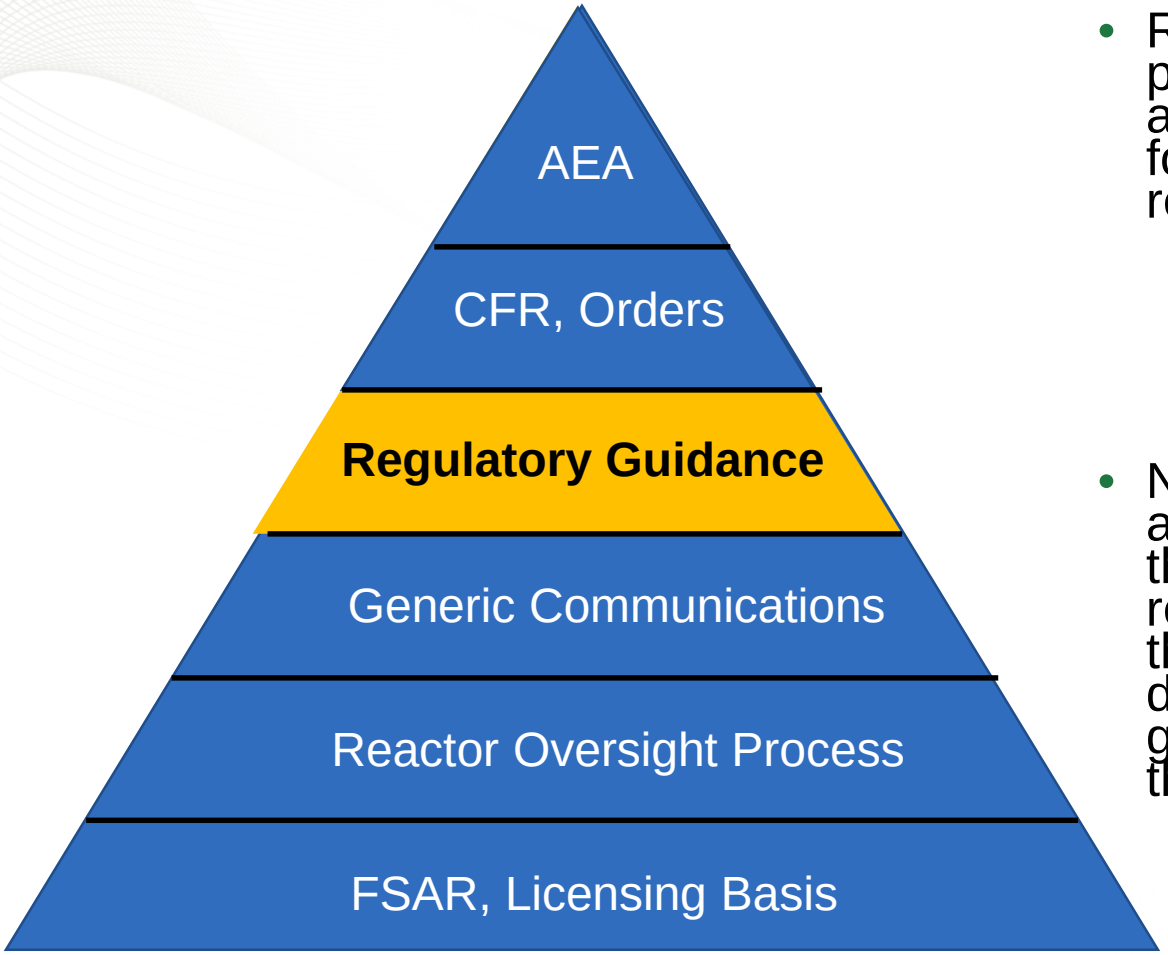
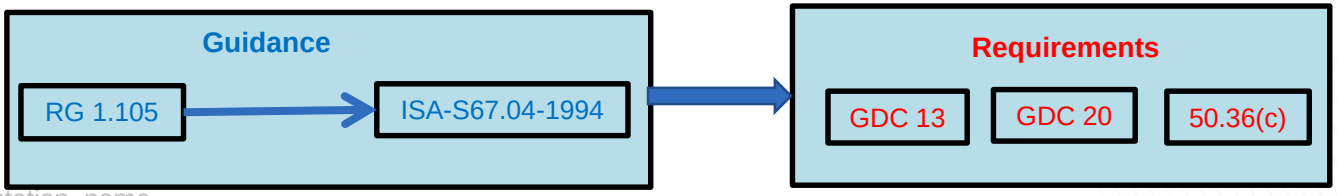
Standards are part of the regulatory basis for LWRs and will be part of the regulatory basis for advanced reactors including MSRs

- Consistent with OMB Circular A119, “Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities,” it is NRC’s policy to use standards developed by voluntary consensus standards bodies if available and appropriate
- Designs can proceed without approved standards; however the NRC incorporates by reference consensus standards
  - to provide regulatory certainty
  - to provide regulatory predictability desired by stakeholders
  - minimizing the expenditure of NRC resources that would otherwise be necessary to develop regulations
- The NRC’s mid/long term action plan recognizes that it has traditionally taken years to develop consensus codes and standards and promulgate a new or revised regulation. The unknown is the number of standards involved and the level of effort needed to revise or develop new standards applicable to non-LWRs

Regulatory Guidance



- Regulatory guidance provides a method acceptable to the NRC staff for satisfying the NRC's regulations
  - The enforceability of guidance and interpretations flows from the regulatory obligations, not from the guidance document itself
- NRC endorses consensus and industry standards through incorporation by reference in regulations and through reference in such documents as regulatory guides, NUREG reports, and the standard review plans
  - Only standards that help to meet a demonstrated need in support of regulatory activities will be endorsed



Content of a standard

- A brief scope statement (typically, one paragraph)
- A set of definitions (specifically applicable to understanding the standard)
- Requirements (in a format suitable to the subject matter)
- References (only those cited in the text)
- Foreword (to explain why the standard was created and perhaps the history of its evolution)
- Appendix (to provide examples of the application of the standard and/or supplemental information)

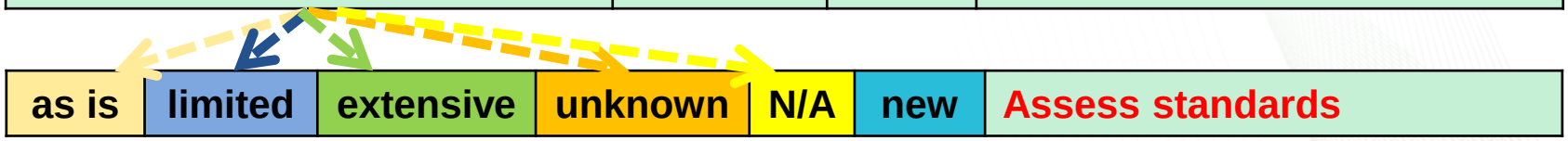
DOE initiated a scoping study to understand the size and scope of expanding the NRC's LWR-specific regulatory framework to SFRs

1. Obtain a list of all standards cited in RGs
   - Standards include consensus standards and industry standards
2. From this list, select a few standards for an in-depth review to assess their potential application for non-LWR technologies
   - Down select the number of standards for review to endorsed standards **(HOW MANY)**
   - Assess the standards **applicability to a sodium fast reactor (SFR)** (i.e., technology specific or technology neutral)
   - Categorize the level of effort required to develop or revise the standard for applicability to an SFR **(HOW MUCH EFFORT)**
3. Describe the process for developing, approving, and endorsing a consensus standard
   - Discuss and estimate the timelines for modifying a standard through the standards committees
   - Discuss the process of citing or endorsing a standard by the NRC

A report on the outcome of this scoping study was completed in Sept 2017

Number of standards assessed*

Standards	Std org	RGs	Coverage
865 citations		486	Div 1-10 RGs
817 citations		225	Div 1 RGs (Power Reactors)
	30	179	Div 1 RGs, Active RGs
114 citations	9	67	Div 1 RGs, Active RGs, Endorsed active standards
71 citations	8	36	Div 1 RGs, Active RGs, Endorsed active standards, no IEEE standards**
60 standards	8	35	Remove duplicate standards



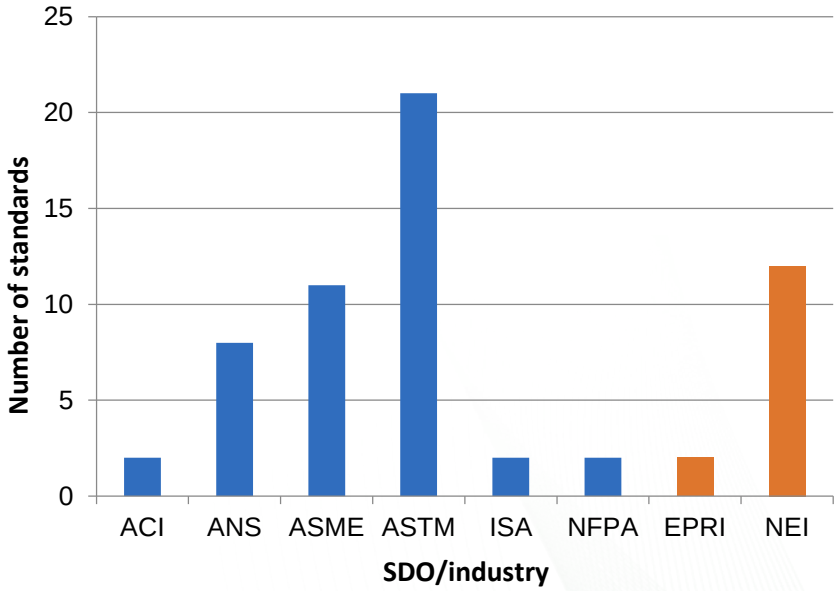
*Database distributed by NRC at the Nuclear Energy Standards Coordinating Collaborative (NESCC) circa 2012 (unpublished)

**IEEE standards are typically technology neutral

How many—60 standards endorsed in 35 RGs

- 6 SDOs, 46 standards
- 2 industry groups, 14 standards

SDO or industry group	No. endorsed standards	Total
ACI	2	46
ANS	8	
ASME	11	
ASTM	21	
ISA	2	
NFPA	2	
EPRI	2	14
NEI	12	
TOTAL	60	



Five “level of effort” categories were used to determine how much effort would be required to revise the standard for applicability to an SFR

A	B	C	D	E	F	G	H	I	J	K	L	M
ID	RG-rev	RG title	GDC	RG cited in SRP section	Standards	Standard title	SDO	Standard cited in SRP section	Change Summary	Level of Effort	Key Technical Issues	Comments, Notes

1 = none

- e.g., grades of fuel oil

2 = limited changes

- e.g., although applicable to all types of NPPs, specifically cites LWRs

3 = substantive changes needed

- e.g., use of sodium presents temperature and level measurement problems

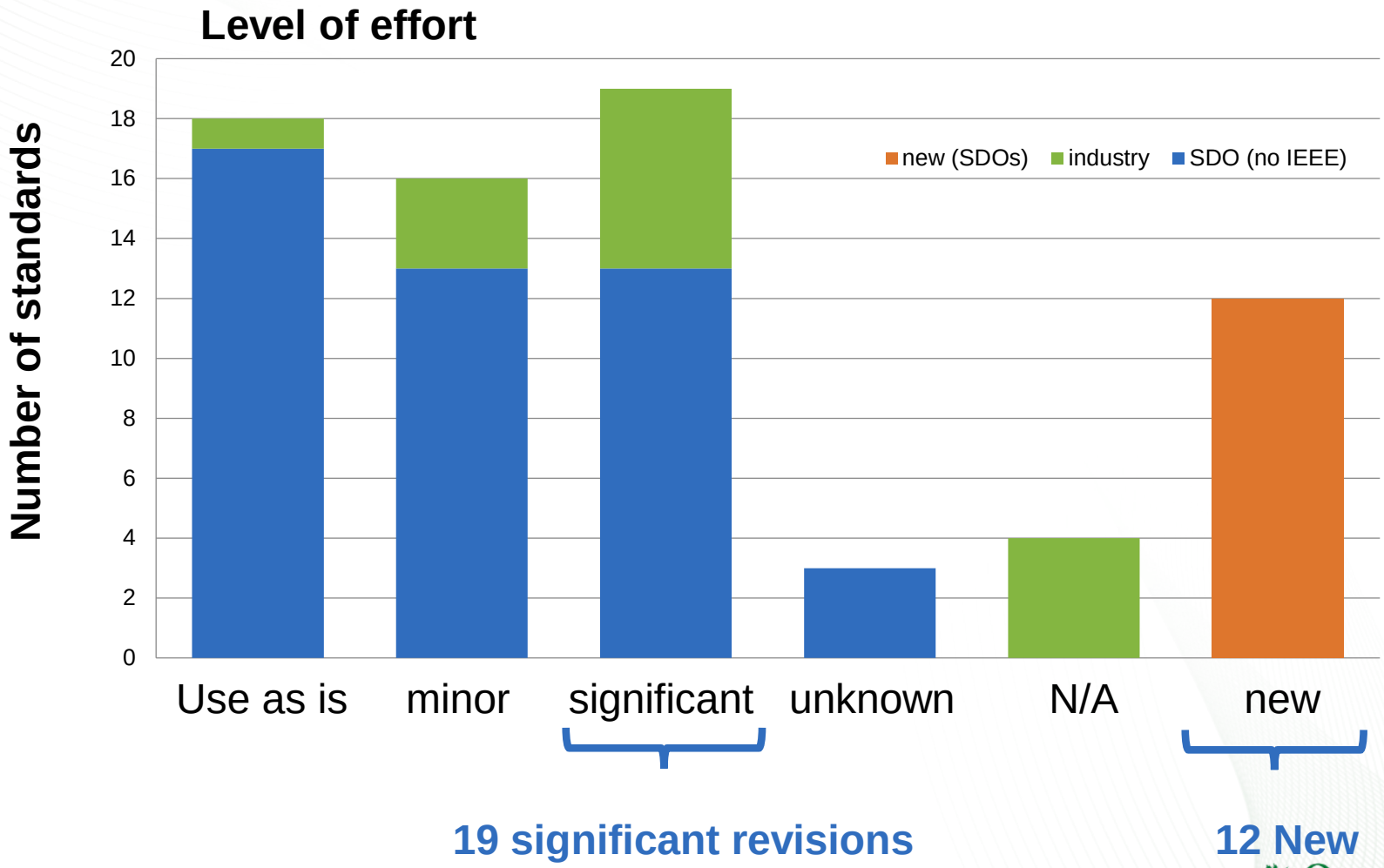
4 = insufficient design info

- e.g., conditions for testing of new and used carbons based on LWR accident conditions

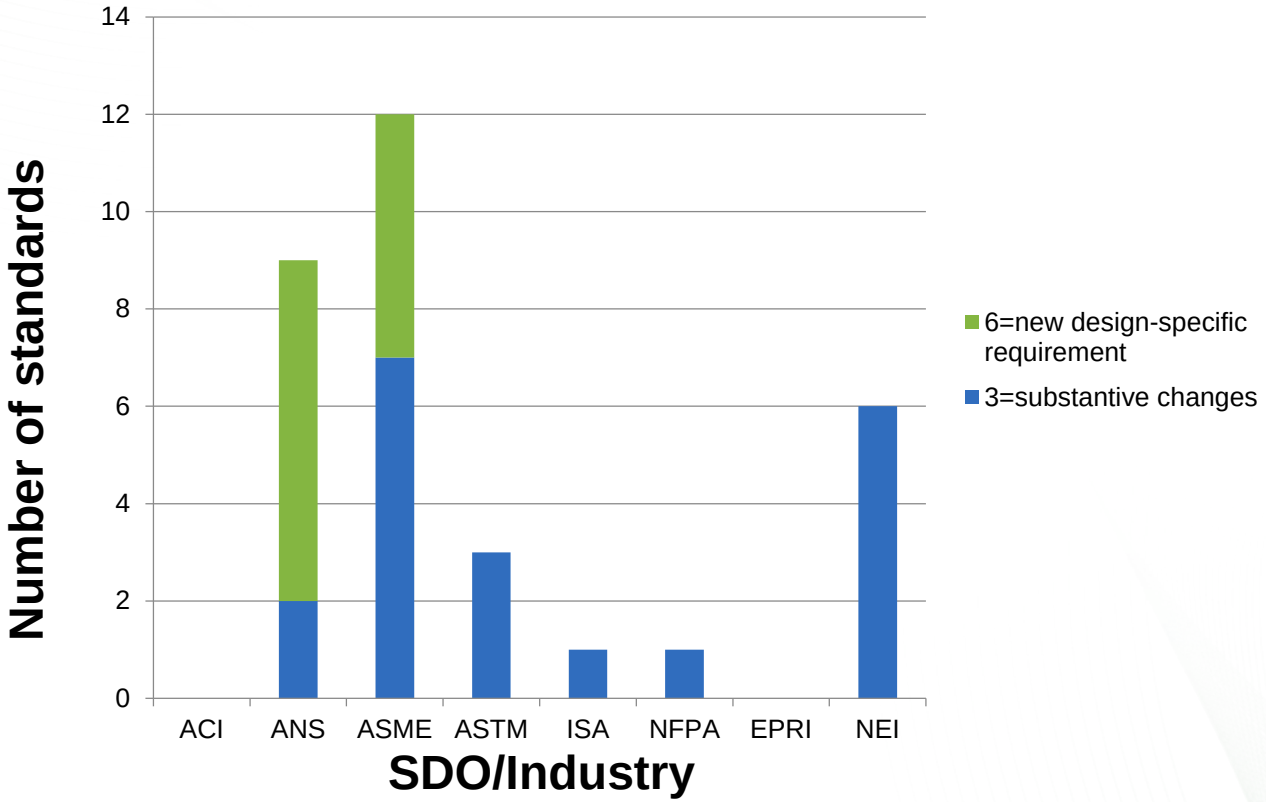
5 = not applicable (N/A)

- e.g., restart after seismic event

How much effort—19 of the 60 active standards endorsed by RGs will require significant revisions (12 new standards are likely to be needed)



Impact could be significant on SDOs/Industry Plant design Start of operations



1. Time for minor changes to a standard to be approved (LOE = 2): 0.5–2 years
2. Time for significant changes to a standard to be approved (LOE = 3): 1–3 years
3. Time for the development and approval of a new standard (LOE = 6): 2–8 years

LOE = level of effort

Summary of results of reviews

- Of the 60 voluntary consensus standards and industry standards endorsed by RGs that have been reviewed, 19 will likely need substantive changes
  - Protective coatings and test methods for protective coatings may differ
  - Temperatures in SFRs may exceed concrete and steel limits in standards
  - Types of steel, concrete, and source terms may differ greatly for SFRs compared to LWRs
  - Those components required to function during a DBA (PA) will be different for SFRs and will require modification to some standards (e.g., seismic, dynamic qualifications)
  - Containments will be different from current plants
  - Fire issues (fire-induced failures, testing, etc.)
  - Presence of sodium affects EQ, habitability, fire, …
- 12 new consensus standards for SFRs will be required
  - 10 SFR-DCs (70–79) identified in DG-1330
  - Passive cooling
  - Passive equipment
- The IEEE standards are technology neutral

Conclusions

- MSRs will have the same issues as SFRs
  - High energy spectrum
  - High temperature
  - Coolant
  - Materials

- Ideal would be 1 standard that addresses multiple technologies (i.e., applicable to MSRs, FSRs, HTGRs, etc.)