Advanced Reactor Stakeholder Public Meeting

August 26, 2021

[Microsoft Teams Meeting]

Bridgeline: 301-576-2978

Conference ID: 442 887 144#

Time	Agenda	Speaker
10:00 – 10:10 am	Opening Remarks	NRC
10:10 – 10:30 am	Part 71 – Transportation Requirements for Micro-Reactors	NRC/NMSS
10:30 – 10:45 am	Material Control and Accounting of Special Nuclear Material of Moderate Strategic Significance (Category II Material): Upcoming Guidance, NUREG-2159, Draft for Public Comment	NRC/NMSS
10:45 am – 12:00 pm	Results of U.S. Nuclear Industry Council's 2021 Advanced Nuclear Survey	USNIC
12:00 – 1:00 pm	Break	All
1:00 – 2:00 pm	Role and Use of Probabilistic Risk Assessment (PRA) in Support of Advanced Reactor Licensing	NRC/NRR and NEI
2:00 – 2:15 pm	Status of Non-Light Water Reactor PRA Acceptability Regulatory Guide	NRC/NRR
2:15 – 2:45 pm	Draft White Paper on Inservice Inspection/Inservice Testing Guidance	NRC/NRR and INL
2:45 – 3:15 p.m.	Update on Advanced Reactor Exports Working Group Report	NRC/OIP
3:15 – 3:30 pm	Future Meeting Planning and Concluding Remarks	NRC/All

Advanced Reactor Integrated Schedule of Activities

Advanced Reactor - Summary of Integrated Schedule and Regulatory Activities

Summary of Integrated Schedule and Regulatory Activities (updated 11/02/2020)

Advanced Reactor Program - Summary of Integrated Schedule and Regulatory Activities*

Strategy 1	Knowledge, Skills, and Capability
Strategy 2	Computer Codes and Review Tools
Strategy 3	Flexible Review Processes
Strategy 4	Consensus Codes and Standards
Strategy 5	Policy and Key Technical Issues
Strategy 6	Communication

Legend

Concurrence (Division/Interoffice)	• EDO Concurrence Period
Federal Register Publication	Commission Review Period**
Public Comment Period	▼ ACRS SC/FC (Scheduled or Planned)
Draft Issuance of Deliverable	External Stakeholder Interactions
Final Issuance of Deliverable	↓ Public Meeting (Scheduled or Planned)

Version 11/2/20

Present Day

Strategy	Regulatory Activity	Commission Papers	Guidance	Rulemaking	NEIMA	Complete	2020												2021											
							Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Development of non-Light Water Reactor (LWR) Training for Advanced Reactors (Adv. Rxs) (NEIMA Section 103(a)(5))																													
1	FAST Reactor Technology				x	x																								
1	High Temperature Gas-cooled Reactor (HTGR) Technology				x	x																								
1	Molten Salt Reactor (MSR) Technology				x	x																								
1	Competency Modeling to ensure adequate workforce skillset					x																								
	Identification and Assessment of Available Codes					x																								
	Development of Non-LWR Computer Models and Analytical Tools																													
	Code Assessment Reports Volumes 1 (Systems Analysis)					x																								
	Reference plant model for Heat Pipe-Cooled Micro Reactor					x																								
	Reference plant model for Sodium-Cooled Fast Reactor					x																								
	Reference plant model for Fluoride-Salt-Cooled High-Temperature Reactor																													
	Reference plant model for Gas-Cooled Pebble Bed Reactor																													
	Reference plant model for Molten Salt Fueled Reactor																													
	Code Assessment Reports Volumes 2 (Fuel Perf. Anaylsis)					x																								
	FAST code assessment for metallic fuel																													
	FAST code assessment for TRISO fuel																													
	Code Assessment Reports Volumes 3 (Source Term Analysis)					x																								

https://www.nrc.gov/reactors/new-reactors/advanced/details#advSumISRA

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Transportable Micro-reactors and the Future

August 26, 2021

Bernie White,
Sr. Project Manager
Division of Fuel Management
Office of Nuclear Safety and Safeguards

Key Messages

- Preapplication meetings are vital
- Stable regulatory framework for radioactive material transportation
- Effective communication is a two-way street

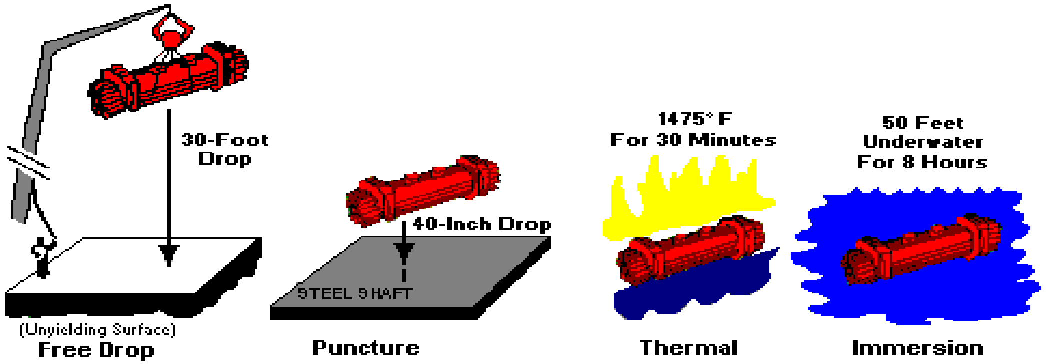
U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Consideration of Various Transport Configurations

- Use of various licenses to transport
  - Unfueled reactor from fabrication facility
  - Fueled reactor from fabrication facility
  - Fueled reactor after low power testing operations
  - Reactor between operating sites
  - Used reactor back to refurbishment facility

Package Approval Regulatory Structure

- Standard Package approval clearly established
  - Specified tests for normal conditions of transport and hypothetical accident conditions
  - Post-test criteria
- Alternative environmental and test conditions in 10 CFR 71.41(c)
- Special package authorization in 10 CFR 71.41(d)
- Exemptions pursuant to 10 CFR 71.12



Role of Transportation in Micro-Reactor Development

- Will the transportation regulations be factored into the design of the transportable micro-reactor?
- Are the transportation regulations in 10 CFR Part 71 a challenge for transportable micro-reactor development or package approval? If so, why?

- We welcome preapplication meetings to discuss micro-reactor package approval for transportation

Bernard.White@nrc.gov

301-415-6577

Advanced Reactor Stakeholder Meeting

Guidance for Material Control and Accounting:

NUREG-2159

Acceptable Standard Format and Content for the Fundamental Nuclear Material Control Plan Required for Special Nuclear Material of Moderate Strategic Significance

Draft for Public Comment

James Rubenstone, Chief
Material Control and Accounting Branch
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
August 26, 2021

Material Control and Accounting

MC&A is a program to control and account for certain types of nuclear material used at a licensed facility, including source and special nuclear material, to deter and detect loss, theft, diversion, misuse, or unauthorized production or enrichment of nuclear material

- **Material Control** – Control access and monitoring status
- **Material Accounting** – Maintain knowledge of location and quantities

MC&A Requirements

General reporting and recordkeeping requirements apply to each person licensed by NRC who possesses, transfers, or receives 1 gram or more of special nuclear material

- Reactors, Medical Isotope Production (Part 50)
- Fuel Cycle Facilities, Greater-Than-Critical-Mass Facilities (Part 70)
- Independent Spent Fuel Storage Installations (Part 72)
- Agreement State Licensees (Part 150)

Special reporting requirements

- Licensees possessing certain source material (Part 40)
- Licensees subject to IAEA safeguards (Part 75)

10 CFR Part 74, Material Control and Accounting of Special Nuclear Material

Graded Approach for MC&A

Specific material control & accounting requirements for licensees who:

- Possess and use SNM of low strategic significance (Category III)
- Possess and use SNM of moderate strategic significance (Category II)
- Possess and use formula quantities of strategic SNM (Category I)
- Possess uranium source material and equipment capable of producing enriched uranium

10 CFR Part 74, Subparts C, D, and E

NUREG-2159, Draft for Comment

- Guidance for implementation of requirements in 10 CFR Part 74, Subpart D
- Similar to existing guidance for 10 CFR Part 74, Subpart C (NUREG-1065) and Subpart E (NUREG-1280)
- *Federal Register* Notice will announce draft for public comment (week of August 30, tentative)
- Provide comments on Regulations.gov
- 60-day comment period

Questions?

- NRC encourages pre-application engagement on MC&A and other topics
- For MC&A, contact:

Tom.Pham@nrc.gov

James.Rubenstone@nrc.gov

https://www.nrc.gov/materials/fuel-cycle-fac/nuclear-mat-ctrl-acctng.html

Results of U.S. Nuclear Industry Council 2021 Advanced Nuclear Survey

For Public Release at

U.S. Nuclear Regulatory Commission (NRC)
Advanced Reactor Stakeholder Meeting
26 August 2021

Cyril W. Draffin, Jr.
Senior Fellow, Advanced Nuclear
U.S. Nuclear Industry Council

Jeffrey S. Merrifield
Chairman, Advanced Nuclear Working Group
U.S. Nuclear Industry Council

Peter Hastings
Vice Chairman, Advanced Nuclear Working Group
U.S. Nuclear Industry Council

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Advanced Nuclear Developers Completing 2021 USNIC Advanced Nuclear Anonymous Survey

Advanced Reactor Developers: USNIC members (17)
Advanced Reactor Concepts
BWXT
Centrus
Framatome Inc.
GE Hitachi Nuclear Energy
General Atomics
Kairos Power, Inc
Lightbridge
MUONS Inc.
NuScale Power
Oklo Inc.
TerraPower
Terrestrial Energy
Ultra Safe Nuclear Corporation
URENCO (U-Battery)
Westinghouse Electric Company
X-energy

Advanced Reactor Developers: Non USNIC members (7) (Part 53 only)
Columbia Basin Consulting Group
Flibe Energy
Holtec
Hybrid Power Technologies
MIT (HTGR)
Southern Company (molten chloride reactor)
Thorcon

Note: This is **comprehensive** survey with **large sample size** of US developers:

- All answers include 100% (1 company, Oklo) in NRC licensing review, 100% (2 companies, X-Energy & TerraPower) with DOE ARDP Demo awards, 60% (3 of 5 companies) with DOE risk reduction awards, and over 80% (5 of 6 companies) of microreactor developers
- For Part 53 questions, survey includes 100% of DOE ARDP Demo, Risk Reduction, and ARC-20 awardees (all 10 organizations). Also, USNIC member and non-USNIC member organizations representing 75% (21 of the 28) non-Light Water Reactor (LWR) designs responded to survey, as well as LWR Small Modular Reactors companies (e.g. NuScale).

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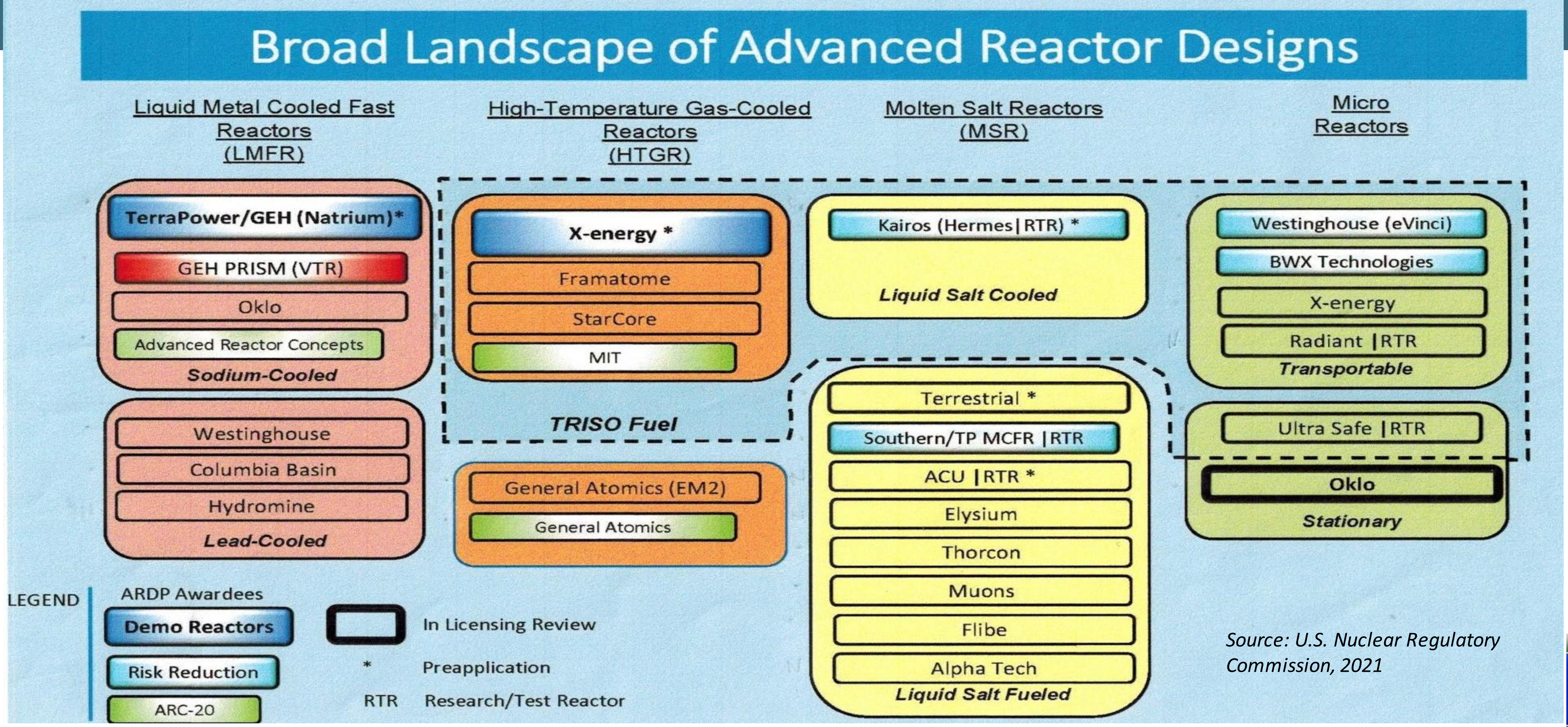
Non-LWR Landscape



Source: U.S. Nuclear Regulatory Commission, 2021

USNIC 2021 SURVEY TOPICS

Policy Issues (Q1-Q3)
Part 53 (Q4-Q9)
Reactor Type, Licensing (Q10-Q12)
US/Canada (Q13-Q15)
EPZ, Operators, Refueling (Q16-Q20)
NRC Fees, EIS (Q21-Q23)
Capitol Hill/States (Q23-Q27)
International/Commerce (Q29-Q32)
DOE Programs (Q28; Q33-39)
HALEU (Q40)
Issues (Q42, Q41)

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Q1: Of the Policy Issues listed below, please rank their individual importance:

1	**Fuel Qualification** [Note: #3 in 2020 survey]
2	**Probabilistic Risk Assessment, Resolve if Graded Approach Allowed or Required to Follow NEI-1804** [#4 in 2020]
3	**Fuel Cycle Facilities, Higher Enrichments, Transportation** [#2 in 2020]
4	**Appropriate Source Term, Dose Calculations, and Siting** [#1 in 2020]
5	**Materials Qualification** [#12 in 2020]
6	**Operator Staffing for Small or Multi-Modular Facilities** [#10 in 2020]
7	Licensing Basis Event Selection
8	Offsite Emergency Planning (EP) Requirements
9	Endorsement of Codes, Standards & Methods
10	Security and Safeguards Requirements
11	Insurance and Liability [#14 in 2020]
12	NRC Planned Rulemaking Modernizing Environmental Reviews
13	Functional Containment Performance Criteria [#5 in 2020]
14	Industrial Facilities Using Nuclear-Generated Process Heat
15	Manufacturing License Requirements [#11 in 2020]
16	NRC & Canadian CNSC Coordination
17	Generic EIS
18	Remote/autonomous Inspections and Monitoring of Operations
19	Operator Training Requirements

*Note: Most important 6 policy issues in **bold***

Blue for Policy Issues listed as more important than 2020 survey; Green with lower importance than prior 2020 survey

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Q1: Of the Policy Issues listed below, please rank their individual importance – Details:

		High importance	Important	Low Importance	Not sure	Weighted Average
1	**Fuel Qualification**	64.7%	17.7%	17.7%	0.0%	2.47
2	**Probabilistic Risk Assessment, Resolve if Graded Approach Allowed or Required to Follow NEI-1804**	53.3%	33.3%	13.3%	0.0%	2.4
3	**Fuel Cycle Facilities, Higher Enrichments, Transportation**	58.8%	17.7%	23.5%	0.0%	2.35
4	**Appropriate Source Term, Dose Calculations, and Siting**	50.0%	28.6%	21.4%	0.0%	2.29
5	**Materials Qualification**	43.8%	31.3%	25.0%	0.0%	2.19
6	**Operator Staffing for Small or Multi-Modular Facilities**	33.3%	46.7%	20.0%	0.0%	2.13
7	Licensing Basis Event Selection	26.7%	60.0%	6.7%	6.7%	2.07
8	Offsite Emergency Planning (EP) Requirements	26.7%	53.3%	20.0%	0.0%	2.07
9	Endorsement of Codes, Standards & Methods	26.7%	53.3%	20.0%	0.0%	2.07
10	Security and Safeguards Requirements	29.4%	47.1%	23.5%	0.0%	2.06
11	Insurance and Liability	23.5%	52.9%	23.5%	0.0%	2
12	NRC Planned Rulemaking Modernizing Environmental Reviews	33.3%	26.7%	33.3%	6.7%	1.87
13	Functional Containment Performance Criteria	20.0%	46.7%	26.7%	6.7%	1.8
14	Industrial Facilities Using Nuclear-Generated Process Heat	26.7%	20.0%	53.3%	0.0%	1.73
15	Manufacturing License Requirements	13.3%	53.3%	26.7%	6.7%	1.73
16	NRC & Canadian CNSC Coordination	23.5%	35.3%	29.4%	11.8%	1.71
17	Generic EIS	20.0%	33.3%	40.0%	6.7%	1.67
18	Remote/autonomous Inspections and Monitoring of Operations	20.0%	26.7%	46.7%	6.7%	1.6
19	Operator Training Requirements	6.7%	40.0%	53.3%	0.0%	1.53

Note: Most important 6 policy issues in bold

14-17 responses for each policy issue, most issues had 16 responses

Blue for Policy Issues listed as more important than 2020 survey; Green with lower importance than prior 2020 survey

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Q2: For policy issues listed in question 1, which issues most need regulatory guidance?

(multiple answers allowed)

1 **Fuel Qualification (1)**	(11 responses) 65%
2 **Fuel Cycle Facilities, Higher Enrichments, Transportation (3)**	(8 responses) 47%
3 **Probabilistic Risk Assessment (2)**	(7 responses) 41%
3 **Operator Staffing for Small or Multi-Modular Facilities (6)**	(7 responses) 41%
5 Offsite Emergency Planning (EP) Requirements	(6 responses) 35%
5 Endorsement of Codes, Standards & Methods	(6 responses) 35%
7 Security and Safeguards Requirements	29%
7 Remote/autonomous inspections and monitoring of operations	29%
7 Generic EIS	29%
10 Licensing Basis Event Selection	24%
10 **Materials Qualification (5)**	24%
10 Industrial Facilities Using Nuclear-Generated Process Heat	24%
13 **Appropriate Source Term, Dose Calculations, and Siting (4)**	18%
13 Insurance and Liability	18%
15 NRC planned rulemaking modernizing environmental reviews	12%
15 Manufacturing License	12%
17 Functional Containment Performance Criteria	6%
17 NRC & Canadian CNSC coordination	6%
17 Operator Training Requirements	(1 response) 6%

Note: Most important 6 policy issues from Question 1 in bold

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Q3: Are there any additional NRC policy issues that need to be addressed to allow your technology to move forward that are not included on the lists above?

- **HALEU transportation regulations**; Packaging and shipping requirements
- **Current requirements for siting outlined in Part 100 are overly prescriptive**; Revisiting siting in a more performance-based manner is a higher priority policy issue
- **Environmental reviews certainly need to be revisited from a regulatory perspective--** The NRC's environmental review is overly burdensome, especially for microreactors, where there is little to no (and often positive) environmental impacts associated with placement of an advanced reactor; The requirements associated with licensing actions designated as needing an EIS versus an EA or even being included in the list of categorical exclusions should be revisited considering certain technologies being proposed
- From 1970 to 1978, the number of regulatory guidance documents and positions expanded from 4 to 304-- During this same time period, nuclear growth reduced dramatically. While guidance can be useful, it should be developed thoughtfully to ensure it does not prohibit growth. In particular, industry should not rush to create guidance in advance of an operating non-LWR fleet, rather allow for guidance that complements lessons learned from early operations to inform guidance
- Harmonization between selected international standards and domestic requirements
- “Non-applicabilities” remain key policy issue that has not yet been resolved-- The NRC maintains a plain read interpretation of the regulations which is counter to NEIMA and creates unnecessary hurdles to the deployment of non-LWRs
- Demonstration of acceptable methods for meeting Quantitative Health Objectives
- Siting and population distance requirements
- QA standards
- Part 53

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USNIC 2021 SURVEY TOPICS – Part 53

Policy Issues (Q1-Q3)
Part 53 (Q4-Q9)
Reactor Type, Licensing (Q10-Q12)
US/Canada (Q13-Q15)
EPZ, Operators, Refueling (Q16-Q20)
NRC Fees, EIS (Q21-Q23)
Capitol Hill/States (Q23-Q27)
International/Commerce (Q29-Q32)
DOE Programs (Q28; Q33-39)
HALEU (Q40)
Issues (Q42, Q41)

For Part 53 questions, very comprehensive USNIC survey with large sample size of US developers, including:

- **100%** (all 10 organizations) of DOE ARDP Demo (2), Risk Reduction (5), and ARC-20 (3) awardees.
- **75%** (21 of the 28) non-Light Water Reactor (LWR) designs (slide 2) being developed (by USNIC member and non-USNIC member organizations responding to survey)

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Q4: How important is Part 53 likely to be to your company in the next 15 years?

USNIC & non USNIC members

		# of companies
High Importance if Written Appropriately	**30%**	7
Important if Written Appropriately	**30%**	7
Low Importance	9%	2
Not sure, depends on the language in final rulemaking (e.g. whether current NRC language is modified)	26%	6
Not sure, depends on our company's design and licensing approach	4%	1
		23

May not add to 100% due to rounding

Q4: How important is Part 53 likely to be to your company in the next 15 years? – Comments

- **Critically important that Part 53 provide for meaningful reductions in review time and cost**, and allows for progressive reduction in licensing risk for a project.
- **We can work with Part 50/52 and RG 1.232. Part 53 will be beneficial in long term**. The key is it must focus on safety and not piles of documents to be reviewed by the NRC. A few safety and performance targets must be established. The regulator must allow the operator/licensee to show compliance.
- Part 53 is more important to a reactor vendor. We are a fuel designer/fabricator.
- Part 53 needs to support, but not require, specific implementation techniques such as LMP. Restrictive/prescriptive requirements around today's tools is to be avoided.
- Will be influenced by the future applicant’s desired licensing approach and not the designer/company licensing approach – Part 53 has to demonstrate a benefit to pursuing that approach versus either Parts 50 or 52
- Need to see if final language justifies using it and also if it is timely with our deployment plans.
- As a HALEU supplier, ability of reactor developers to get their designs to market will define the HALEU market

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Q5: How important is a usable Part 53 (that is flexible enough and without undue regulatory burden) to U.S. Advanced Reactor Industry?

USNIC & non USNIC members

Essential for longer-term deployment of commercial Advanced Nuclear Reactors in the US (i.e. industry may not survive without appropriate Part 53)	44%	**91%**	10
Important for deployment of commercial Advanced Nuclear Reactors in the U.S.	30%		7
Desirable for deployment of commercial Advanced Nuclear Reactors in the U.S.	17%		4
Not critical as we can work within existing regulatory framework (Part 50 and 52)	9%		2
Not that important	0%		0
			23

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Q6: Assuming Part 53 is useful, when do you expect to need Part 53 to be completed to support your application?

USNIC & non USNIC members

2024-2025	26%	6
2026-2027	17%	4
2028-2030	17%	4
After 2030	17%	4
N/A, not expecting to use Part 53	22%	5
		23

Q7: How satisfied are you with the usefulness of Part 53 based on current (ML21148A062) language and explanations provided by NRC

USNIC & non USNIC members

Excellent, one of the best draft regulations	0%		0
Very satisfied, comprehensive and useful	0%		0
Somewhat satisfied, needs improvement in a few locations	41%		9
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Somewhat dissatisfied, substantial changes are necessary	36%	**59%**	8
Very dissatisfied, not useful with only limited improvement of current Part 50 and 52	5%		1
Not helpful at all so far	18%		4

22 organizations

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Q8: Comment on Part 53 issues – Potential Delay

USNIC & non USNIC members

We would accept a delay in the development of Part 53 to ensure it meets the needs of the industry and the regulator	**71%**	15
We prefer development of Part 53 on its current schedule	29%	6
		21

Comments:

- More important for Part 53 to be useful and less burdensome than timely. Timeliness should not be the key measuring stick
- Absolutely vital that we give the regulator and industry enough time to coordinate to create a useful regulation
- Not currently intending to license in the US

Continued on next page

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Q8: Comment on Part 53 issues – Potential Delay (continued)

USNIC & non USNIC members

Comments (continued):

- Complexity and cost associated with the NRC have resulted in decision by our management to de-prioritize interactions with the regulator. For that reason, detailed knowledge of Part 53 – its nuances and potential – is limited in our company. By default, preference is given to Part 50 due to its more-tested nature, and due to costs and difficulties in recent attempts to use Part 52.
- Our preference would be for Part 53 to be complete on its current schedule and to meet the needs of the industry/regulator; however, we would accept a minor delay to ensure proper formulation of the rule
- We feel an allowance for delay will not result in a better product, just a longer time schedule.
- We plan on using a traditional 10CFR50 PSAR/FSAR approach using justifications for modifying changes to the existing requirements where requirements are not germane to non-light water reactors. We view the proposed 10CFR53 as more or less useless.

Q8: Comment on Part 53 issues – PRA

USNIC & non USNIC members

We plan on using significant PRA input (similar to LMP)	**35%**	6
We plan on using medium PRA input (similar to existing regulatory framework)	24%	4
We plan on using minor PRA input (similar to maximum credible accident approach)	29%	5
We plan on taking another licensing methodology approach	12%	2
		17

Note: (a) Only 35% plan on using significant PRA input; 65% plan to use medium/minor/no PRA input.
(b) Parenthetical similarities present an example– a developer using LMP may use PRA consistent with existing regulatory framework in terms of what goes into the application.
(c) Future discussion will be required as NRC presents Graded PRA approach, recognizing only a minimal PRA may be appropriate at the Construction Phase.

Q8: Comment on Part 53 issues – QHO

USNIC & non USNIC members

Yes, Include quantitative health objectives	36%	5
No, do not include quantitative health objectives	**64%**	9
		14

Comments:

- Include quantitative health objectives only if guidance is available to demonstrate how to meet and is only an initial licensing requirement
- Subpart H is of interest to our company to expand the available options for phased/progressive licensing of designs and projects
- What we plan to do in near-term implementation should not be driver for content of the rule if it is going to make it prescriptive for all technologies

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Q8: Comment on Part 53 issues – Other Comments

Comments:

USNIC & non USNIC members

- Part 53, and NRC more broadly, should be capable of the eventual licensing and regulation of thousands of reactors (Large and small reactors, electricity and non-electricity, mobile and stationary, terrestrial and marine).
- Must get rid of ALARA and should push for reasonable response to accidents. Should have quantitative health objectives and liability tied to measured exposures in the event of a release. Our experience base is too small to support proper use of PRA; expect this is true for most novel reactor designs. So PRA in a few areas but mostly we expect to use a demonstration reactor.
- Emergency Preparedness section is under revision but still references 50.47. This is critical issue for Advanced Reactor developers. The planning zones should be based on risk analysis for the maximum credible event. Licensee's must be responsible to provide local authorities with information and facilities to coordinate their responses and public information, however, licensee's cannot compel local officials to perform their duties. NRC licensing should require that a licensee provides all necessary training, event information, and facilities for coordination and public information, but not be held responsible for performance of public agencies it cannot control.

Continued on next page

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Q8: Comment on Part 53 issues – Other Comments
(continued)

USNIC & non USNIC members

Comments (continued):

- NRC staff single mindedly focus on using the underlying Congressional Act driving 10CFR53 development as a springboard for inserting new requirements, staff guidance, and staff desires into a major change in the Code of Federal Regulations. Such silo vision is utterly unhelpful for moving advanced reactors forward because much simpler, least cost and most effective solutions are ignored.
- We applaud the efforts of DOE and NRC to modernize and expand the licensing process and design requirements to address development of non-LWR and smaller scale power reactors.
- NRC seems to be losing sight that Congress wished them to take advantage of the increased safety of the advanced reactors by reducing burden, not increasing the requirements for safety. Demonstrating adequate protection of public health and safety (dose) should be the primary goal. The design and the analysis of the plant will dictate the systems needed to ensure that dose limit is not exceeded. PRA can be used to inform the design as determined by the applicant, but should not be mandated for the design of the plant. A full PRA for operation may be expected or desired unless the risk of operating the plant is extremely low (microreactors).
- Long term must recognize that opponents use cost and safety fear as primary tool to eliminate nuclear from the natural dominance it should have in electricity generation. Must get rid of ALARA. Must have defined, sane compensation for exposures.

For additional Part 53 developer comments, contact POC at end of this document

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Q9: Do you plan to use Licensing Modernization Project methodology in your licensing application?

USNIC & non USNIC members

Yes	21%	**33%**	5
Yes, with modifications	12.5%		3
Not decided yet	54%		13
No — e.g. use Performance-based deterministic approach, such as MCA approach	12.5%		3
			24

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Q10: What Part do you plan to use (or have used) when you file your first licensing application?

USNIC & non USNIC members

Part 50	42%	10
Part 52	17%	4
Part 53	4%	1
Other	37%	9
		24

Part 50 / Part 52:

- Part 50 provides more flexibility than Part 52.
- Currently plan to use Part 50, however, we will consider using Part 53 if available and does not require definitive design before a construction permit application.
- Current plans to use Part 50 for our demonstration reactor unless Part 53 is available in time.

Part 53:

- May not be possible to use Part 53 if application filed before final Part 53 is released

Other:

- Note: Other includes companies planning to use 50/52 (have not decided) or not to file in U.S.
- Planning for Standard Design Approval application under Part 52; however construction licensing process has not yet been determined and is the purview of the future licensee on how to proceed.
- Fuel supply only-- likely Part 50 with Part 52 possibility

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USNIC 2021 SURVEY TOPICS – Multiple

Policy Issues (Q1-Q3)

Part 53 (Q4-Q9)

Reactor Type, Licensing (Q10-Q12)

US/Canada (Q13-Q15)

EPZ, Operators, Refueling (Q16-Q20)

NRC Fees, EIS (Q21-Q23)

Capitol Hill/States (Q23-Q27)

International/Commerce (Q29-Q32)

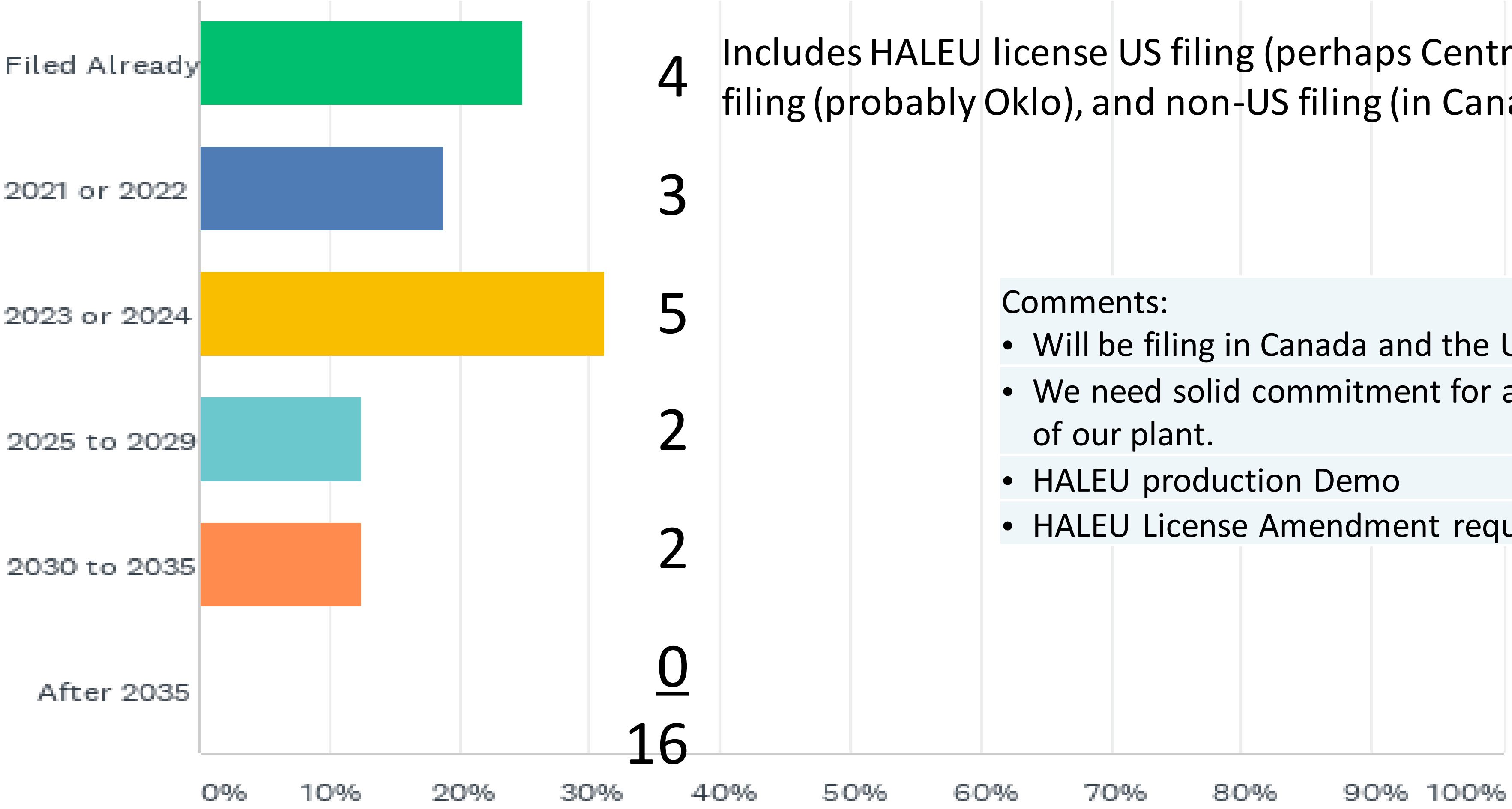
DOE Programs (Q28; Q33-39)

HALEU (Q40)

Issues (Q42, Q41)

Q11: When do you plan to file your first licensing application?

USNIC members



Includes HALEU license US filing (perhaps Centrus), US reactor filing (probably Oklo), and non-US filing (in Canada/UK)

Comments:

- Will be filing in Canada and the UK only
- We need solid commitment for at least 6 units of our plant.
- HALEU production Demo
- HALEU License Amendment request approved

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Q12: What reactor size, number of modules, and technology type? (multiple responses allowed)

USNIC & non USNIC members

ANSWER CHOICES	
1-50MWe Reactor	9
50-200 MWe Reactor	10
Over 200 MWe Reactor	7
Range of modules at site (for most applications): 1-5	15
Range of modules at site (for most applications): 6-12	4
Range of modules at site (for most applications): Over 12	1
Light Water Reactor	4
High-Temperature Gas Cooled Reactor	8
Molten Salt Reactor	5
Sodium Cooled Reactor	3
Other technology or additional information - e.g. Heat pipes, other HTGR	12

<u>Other technology</u>
High Temp Gas Fast Reactor with Brayton Cycle
HTGRs from 20 MWe to 625 MWe per module
Heat pipe reactor
Heat pipes
Hybrid that uses nuclear and fossil fuel.
Fast spectrum reactor utilizing lead-bismuth eutectic primary coolant
Reactor operated under Class 104c license
HALEU production
Fuel only
Deconversion, expansion of enrichment segment

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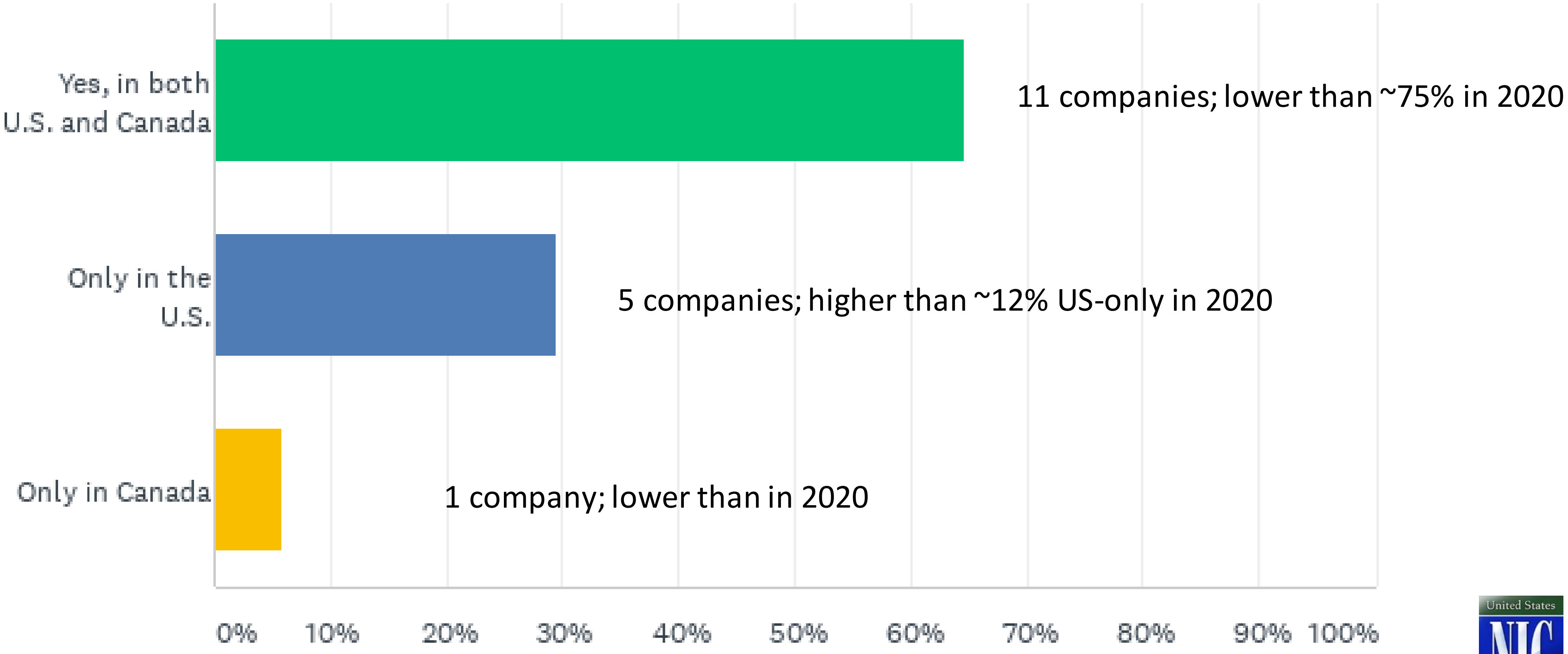
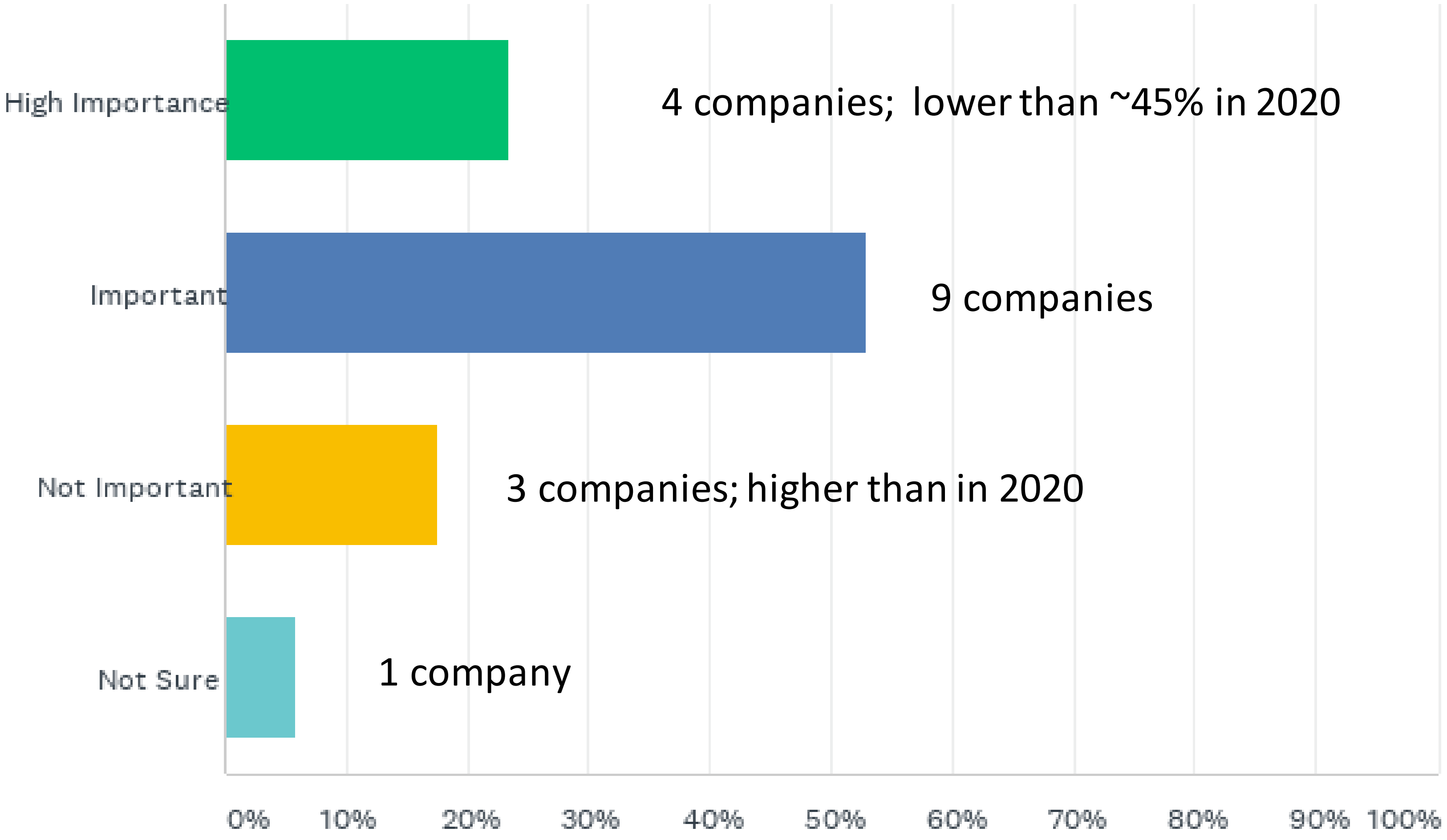
Nuclear Industry Council

Q13: Does your company intend to pursue licensing in both the United States and Canada?



Other countries/regions: UK, eastern Europe, the Middle East, Southeast Asia and Africa

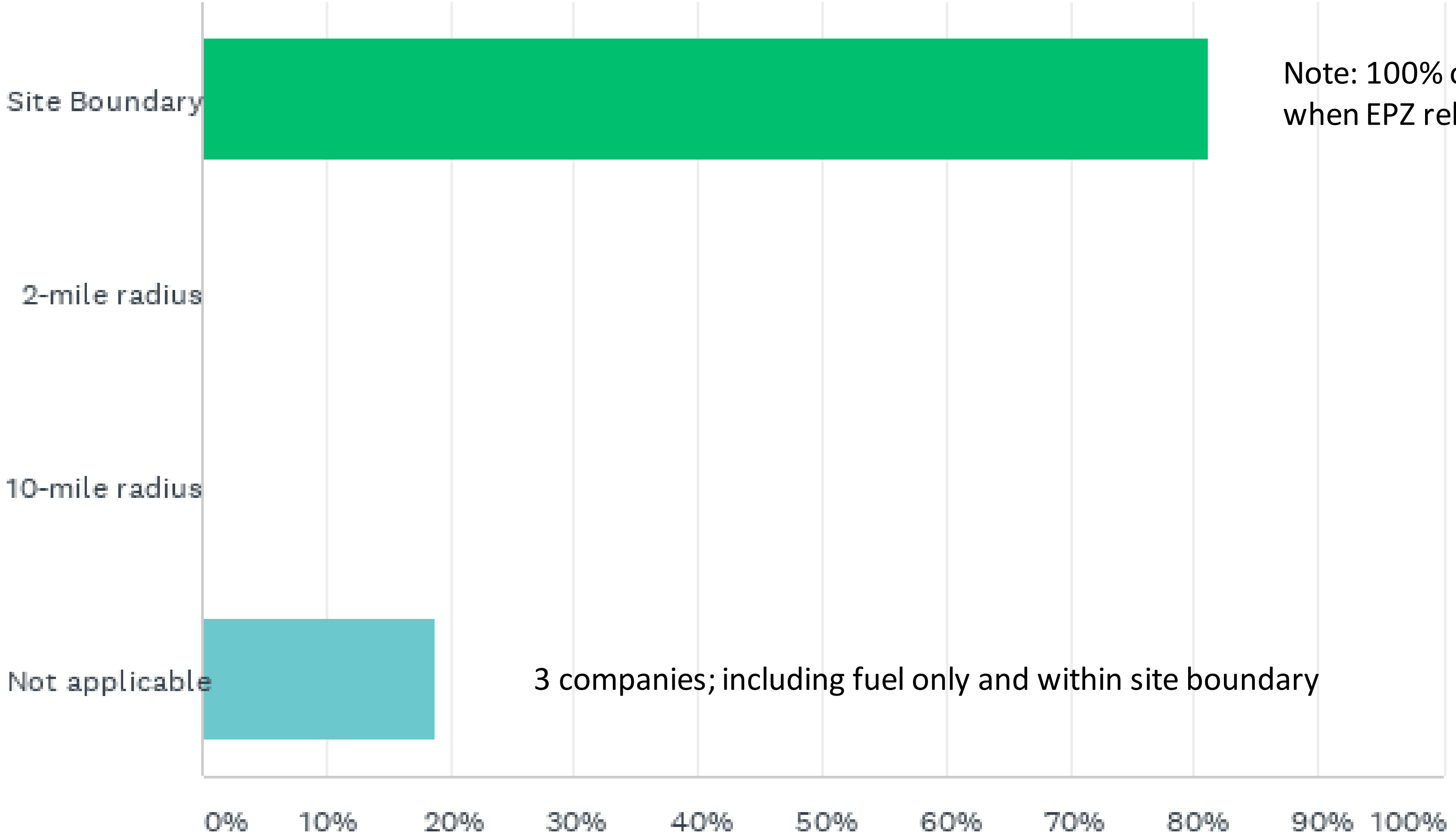
Q14: Does your company support the effort of the U.S. NRC and the Canadian CNSC to align their regulatory review processes?



Q15: Are there actions that the NRC/CNSC and/or Industry can undertake to resolve these regulatory review issues, or alternatively, are there other areas where the NRC and CNSC could collaborate?

- **Comity/parity to avoid having to undergo duplicative licensing proceedings**
- **Cross border transportation of HALEU**
- Harmonized standards e.g. ASME and NQA-1
- Increased reciprocity
- CNSC could clarify its process for an approved NRC license.
- If technology proposed for deployment is identical, approach where approvals can be streamlined with requisite modifications to meet specific regulatory criteria in each country

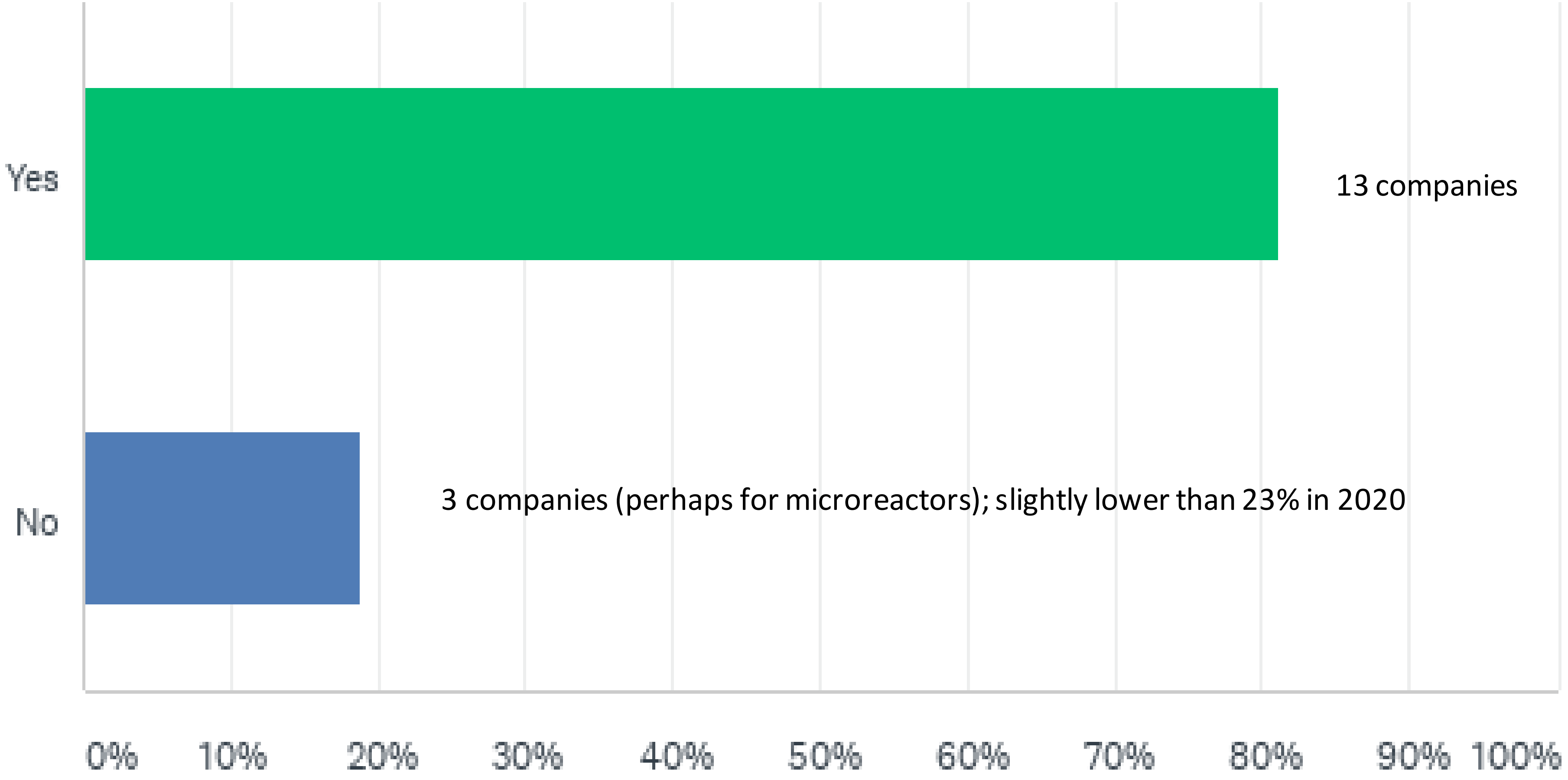
Q16: What is the appropriate Emergency Planning Zone for your technology?



Note: 100% of developers (13 companies) when EPZ relevant

3 companies; including fuel only and within site boundary

Q17: Does your plant design require control room operators to operate the plant?



Q18: If you answered no to question 17 (i.e. plant design does not require control room operators to operate the plant), please explain why not?

- Being designed for autonomous operation; Plant will be autonomous once start-up has been completed after refueling with remote monitoring; Only remote operation intended to be available is reactor trip
- Our smallest reactor can operate autonomously, but we are not pursuing that until a real demand materializes
- Facility is designed to operate with minimal human interaction and has no safety-related human tasks
- "Operate" does not imply safety-related operator actions
- Fuel only – depends on plant license, but most probably yes

Note: HALEU plant requires 24x7 operators

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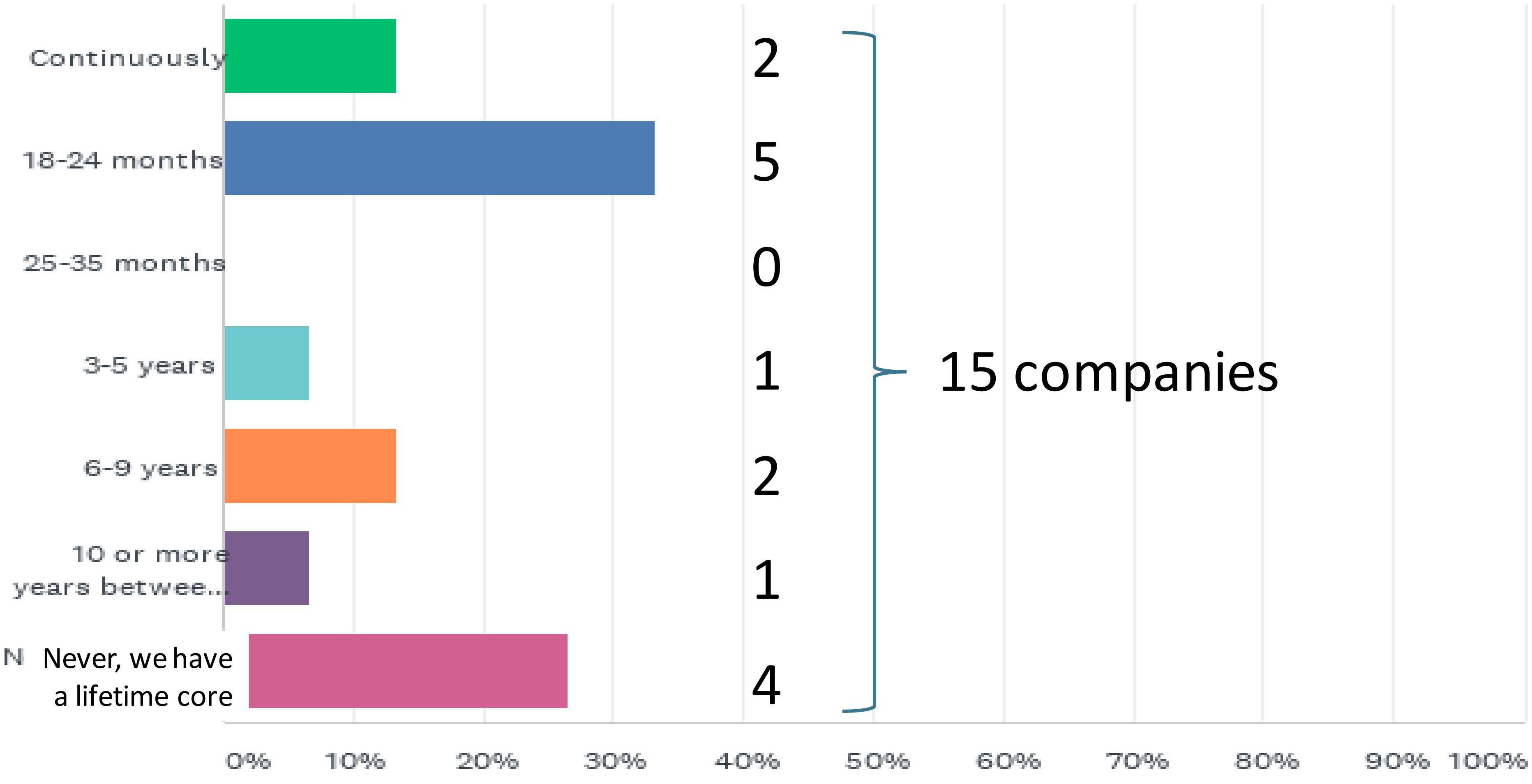
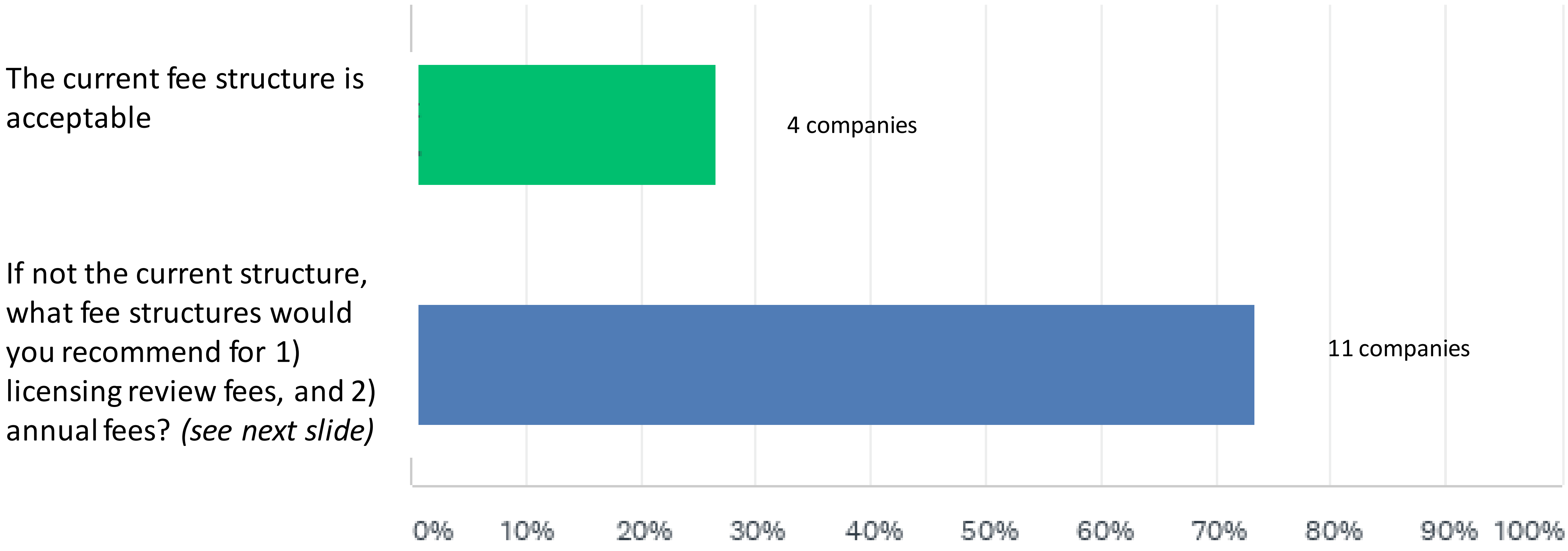
Q19: If you answered yes to question 17, how many operators will be required for your commercial advanced reactor design?

Total number of control room operators per shift?	Total number of modules (when fully built out)?	Will the control room operators be on site or located off-site?	Will there be any variance in the number of control room operators during overnight hours and weekends?	Any substantial change in expected operators from last year?
3	4	on-site	no	no
3 operators per shift for 4-module plant	Fours module for our largest plant	on site	no	no
Fuel only. Depends on plant license.	Fuel only. Depends on plant license.	Fuel only. Depends on plant license.	Fuel only. Depends on plant license.	Fuel only. Depends on plant license.
2-3	varies - up to 4	on-site	no	no
TBD	Two Units	on-site	TBD	no
		on site		
3	6-12	on-site	This is a Licensee choice (we are a vendor)	NRC approved reduction from six licensed operators to three for twelve module plant with single control room, and approved elimination of STA position.
TBD however control multiple reactors	>5	on site	TBD	no
1	2	on-site	no	no

Q20: How often do you intend to refuel?



Q21: What is an appropriate Nuclear Regulatory Commission fee (for the current regulatory framework and desired future regulatory framework)?



See comments on next slide

Q21: What is an appropriate Nuclear Regulatory Commission fee (for the current regulatory framework and desired future regulatory framework)?

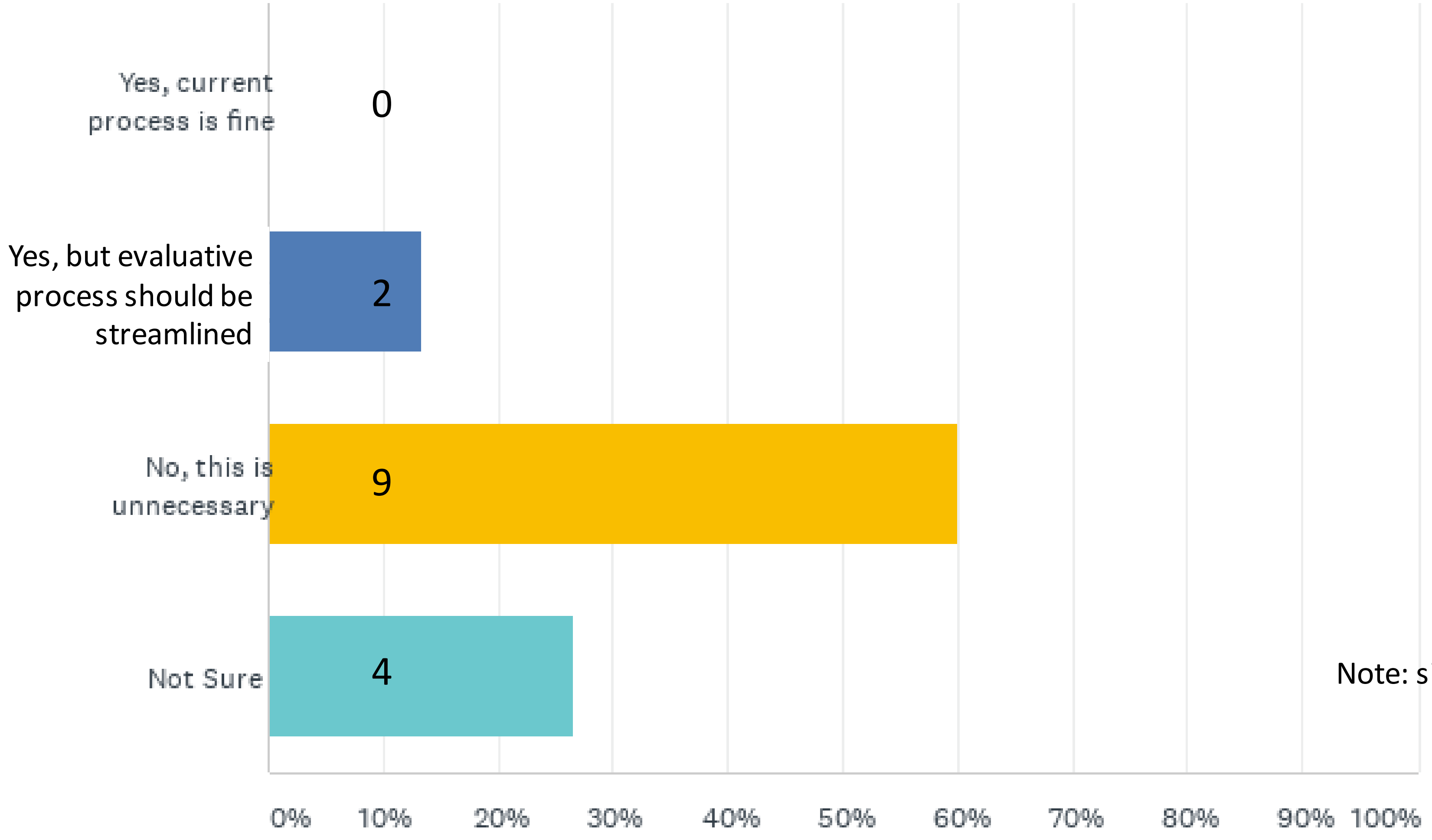
- Fee should be scaled to power level and plant safety profile
- Without legislative action, annual fees should reflect the level of staff effort as this is a zero sum game and no licensee should be disproportionately burdened by other licensees. Legislation should be pursued to recognize the zero carbon societal benefit of nuclear and to make cost recovery commensurate or favorable when compared to carbon producing technologies
- A per-review hour fee basis represents a significant challenge for regulatory reviews of new designs given the uncertainties associated with novel applications and technologies. We support many of the proposals made by NIA such as exclusion of new license fees for activities such as NEPA compliance and pre-application engagement, and consideration of capped or flat application fees. Consider deferred fees
- NRC fee structure should be entirely revamped. The current structure disincentives timely and efficient reviews. Current fee structure creates a significant barrier to entry for nuclear reactor companies, especially small businesses. Instead, smaller subset of fees should be assessed for certain applications and allow for broader entry availability. For annual fees should be revisited for whether they are truly necessary. Recent reports suggested alternative fee structures be looked at for applicability, including EPA, FDA, and FAA. These structures recognize the public benefit incurred as a result of the associated reviews, and therefore set the expectation that public share in regulatory costs associated with such activities. Under the current structure, microreactor annual fees should be no greater than those applied to research and test reactors
- Support a fee structure similar to the ones described as "Alternative 2" or "Alternative 3" *(slides 12 and 13)* presented by NEI at ARRTF Stakeholder Meeting on April 15, 2021
- The NIA recommendation on fee reform is worth pursuing

See additional comments on next slide

Q21: What is an appropriate Nuclear Regulatory Commission fee? – broader issue of cost reduction

- Cost reduction is vital through risk-informing the review and reducing review scope to only what is safety-significant
- Continually negotiate the scope of various engagements, and ensure all questions are approved by NRC management prior to the vendor spending time on it
- Define and enforce scope of ACRS reviews
- Reduction in overhead cost (e.g., PMs)
- Audit charges were large because of scope creep and continuous timeline extension. Need more focused audits
- See NEI's recent NRC letter on reducing Licensing cost, dated 6/9/21, "NEI Input on Recent Application Experience for New Reactors," ML21160A246

Q22: Should the NRC EIS process include a need for power analysis?



Note: similar results in 2020

Q22: Should the NRC EIS process include a need for power analysis? – Comments

- Need to replace/decarbonize electricity generation is common and well understood by policy makers and regulators
- The operator licensee should determine need, not the NRC!
- Assume that there is a power need, otherwise a plant would not be proposed.
- Many advanced reactors, especially microreactors will benefit from a power analysis performed, however it should not be necessary to support the environmental review.
- The defense of purpose and need is the underlying requirement and must be addressed. The NRC staff have not said that they cannot evaluate an application without addressing "need for power"; what they have said is that it has not been worth the effort to develop guidance, absent a demand signal for non-power applications. There are individuals within the staff that don't quite understand this, but in the main, middle and senior management seem to get it.
- The need for power or process applications would be one of several topics used to support the Need for the proposed action. It must not be the singular reason for the action. For large scale facilities, the Need for Power was the dominant reason that was used to offset the large potential negative impacts in the cost benefit balancing that is the result of the EIS.

Additional comment on next slide

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Q22: Should the NRC EIS process include a need for power analysis? – Comments (continued)

- The NEI comments on Draft Micro-Reactor Applications COL-ISG-029, "Environmental Considerations Associated with Micro-Reactors" addressed this matter: "… two would be project proponents for advanced reactors: governmental authorities and private corporations, both of whom, as a practical matter, are unlikely to change their business plan based on the NRC's alternative analysis. Consider that: (1) if the impetus to increase or generate power reflects a governmental decision (for sites in which energy facilities are regulated by a public utilities commission or co-located on government property), the need for power analysis has already been performed by the government applicant; or (2) if the impetus to provide power, either electric or nonelectric, is a private party decision, the project proponent would have already performed the analysis and will bear the risk of the need for power associated with the project. Further, for many new reactor projects the selected site will be the only site available, for example it may be co-located with an existing generation source, providing heat to an industrial facility, or providing secure power to a Federal facility. Similarly, for non-electric applications such as process heat and desalination, the market would make the decision regarding whether to use nuclear technology and, if so, what type should be use."

  While advanced reactor projects commissioned by the Federal government should be still perform the necessary confirmation that the power is needed by a key stakeholder (presumably another government facility), private parties funding the implementation of an advanced reactor at a given site should receive the presumption of having appropriately identified a need for the power.

Q23: Are there other special operating characteristics for advanced nuclear that the NRC and the CNSC (if applicable) should consider?

- Inherent safety of designs that require no active safety systems to unsure operator and public safety
- Treatment of Inherent Design Features in the regulatory framework (i.e., technical basis for reliability of an inherent feature)
- Recognition of inherent safety characteristics in licensing process
- Consider only credible design basis events (rather than core damage as a required design basis event despite being non-credible, as described in NuScale's Lessons Learned Letter, ML21050A431)
- Digital circuitry monitoring and requirements for online testing (digital twins)
- Appropriate staffing and EPZ size reduction *(as discussed elsewhere in the survey)*
- Fuel only-- Depends on the plant design

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USNIC 2021 SURVEY TOPICS – Capitol Hill/States & International

Policy Issues (Q1-Q3)

Part 53 (Q4-Q9)

Reactor Type, Licensing (Q10-Q12)

US/Canada (Q13-Q15)

EPZ, Operators, Refueling (Q16-Q20)

NRC Fees, EIS (Q21-Q23)

Capitol Hill/States (Q23-Q27)

International/Commerce (Q29-Q32)

DOE Programs (Q28; Q33-39)

HALEU (Q40)

Issues (Q42, Q41)

United States NIC Nuclear Industry Council

Q24: Please rank what Capitol Hill actions could be taken in the next few years that would be most helpful to developing and deploying Advanced Nuclear?

1	Create an Investment tax credit for new nuclear plants
2	Federal clean (non-emitting) energy standards that explicitly include nuclear
3	Carbon tax
4	Modify the current new nuclear Production tax credit (45J)
5	Co-funding of Advanced nuclear projects (beyond current DOE ARDP projects & DOD mobile microreactor project)

Q25: If you answered "Other" in question 24, please elaborate

- ITCs represent best option to promote deployment of advanced nuclear; Other options would include milestone based funding that uses funding distributions tied to milestone achievements to foster efficient use of government funding
- Support funding for development / de-risking the HALEU fuel cycle
- Financial backing to build out US technology HALEU supply ahead of commercial market need
- Congress needs to push the executive branch to move forward on HALEU fuel supply via a competitive commercial process which takes advantage of existing capabilities, facilities, and licenses in the US
- Authorize PPAs that include non-power grid reactors for DOD installations and for the processed heat required manufacturing sector
- Tax incentives to consumers of large processed heat requiring should they employ nuclear to meet their needs
- Congress should look at ways to incentivize the utilities to employ GEN IV reactor technologies
- Fix NRC license review fee and schedule

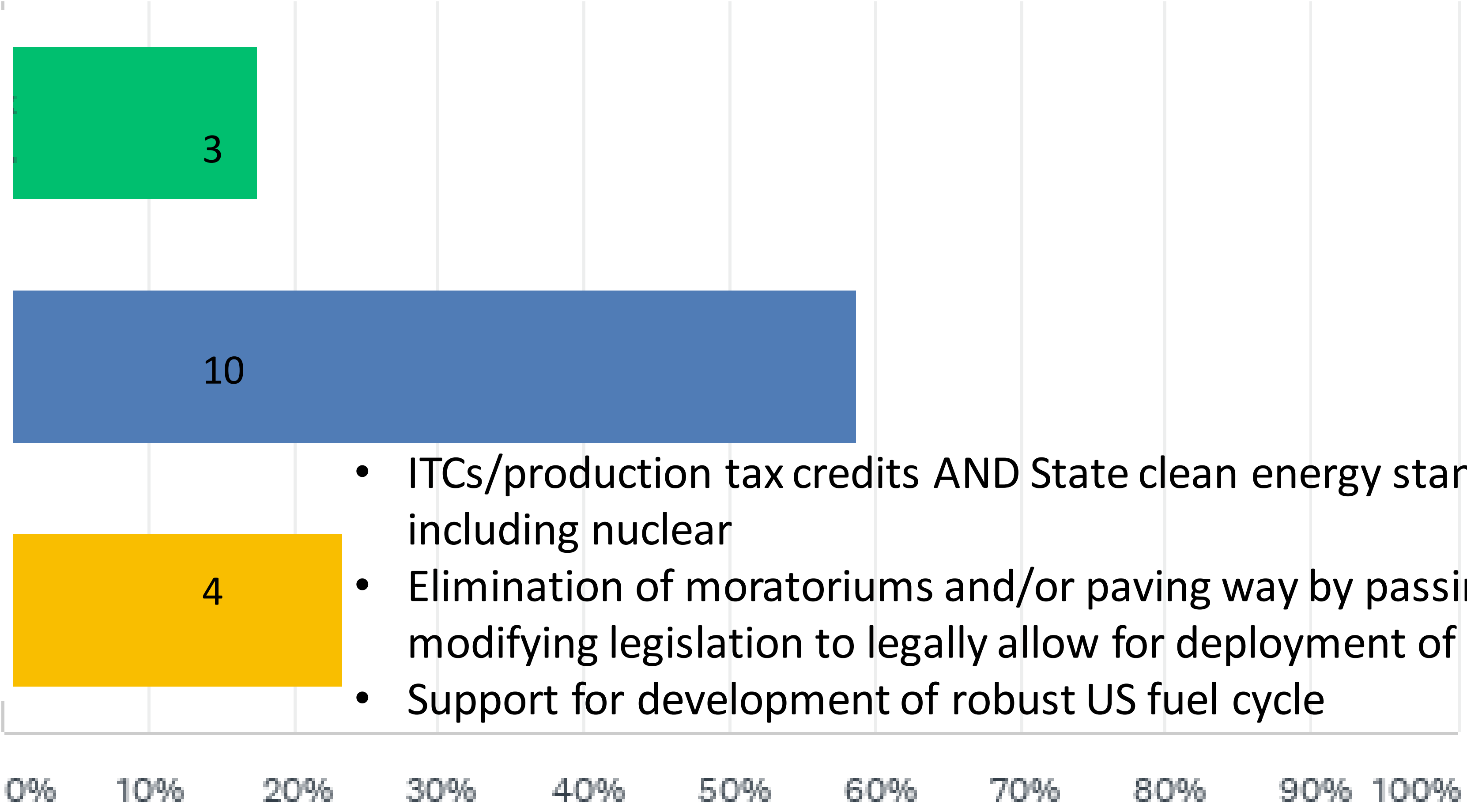
United States NIC Nuclear Industry Council

Q26: What State actions could be taken in next few years that would be most helpful to developing and deploying Advanced Nuclear?

Investment tax credits (ITCs) or production tax credits

State clean (non-emitting) energy standards that explicitly include nuclear

Other



- ITCs/production tax credits AND State clean energy standards including nuclear
- Elimination of moratoriums and/or paving way by passing or modifying legislation to legally allow for deployment of nuclear
- Support for development of robust US fuel cycle

Q27: What States should be focused on first?

- Virginia, Wyoming, Idaho, Washington
- Virginia (state has nuclear strategic plan)
- Ohio, Tennessee, North Carolina
- Alaska, Puerto Rico
- Maryland, Texas
- States with existing nuclear plants in jeopardy of pre-mature closure
- Should be all 50 state policy; however, if targeting states begin in de-regulated state markets

Actions: Establish a value for non-emitting to level the playing field with otherwise mandated renewable portfolios; Inclusion of nuclear in clean energy standards; Include nuclear as clean true-green power

Q28 in DOE section before Q33

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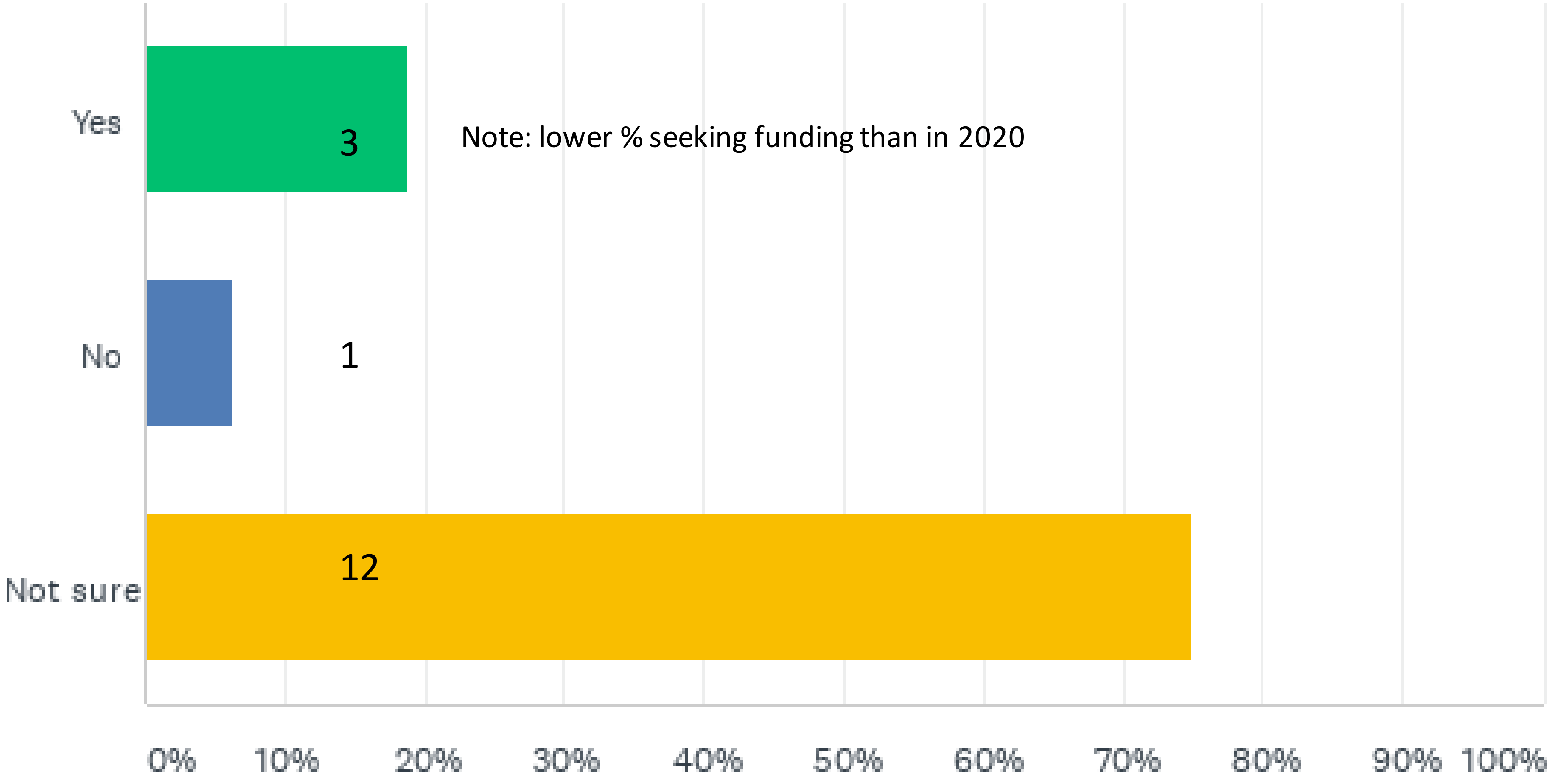
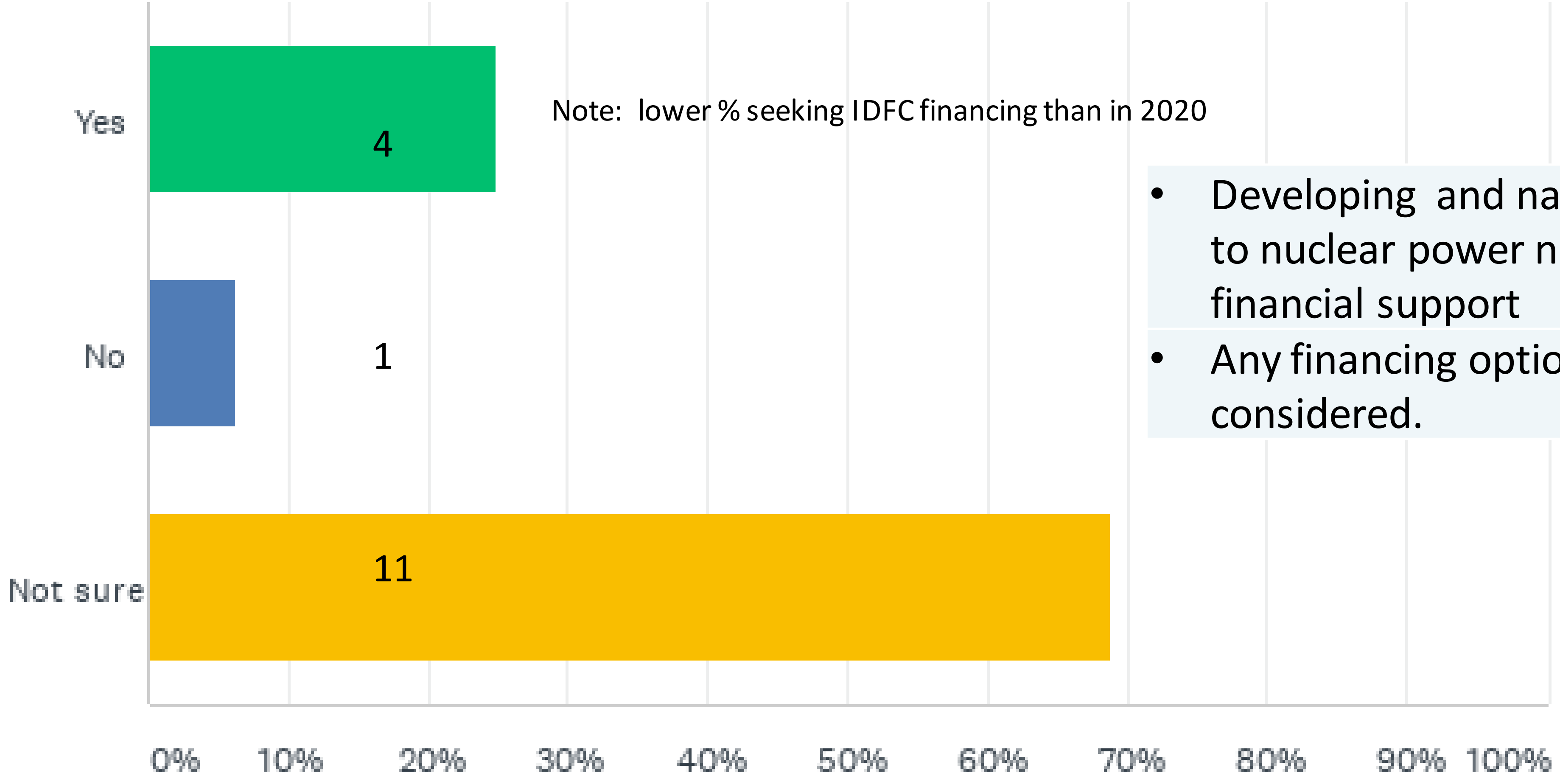
Q29: If you are seeking to export your design, do you intend to seek support from the Export-Import Bank or U.S. International Development Finance Corporation?



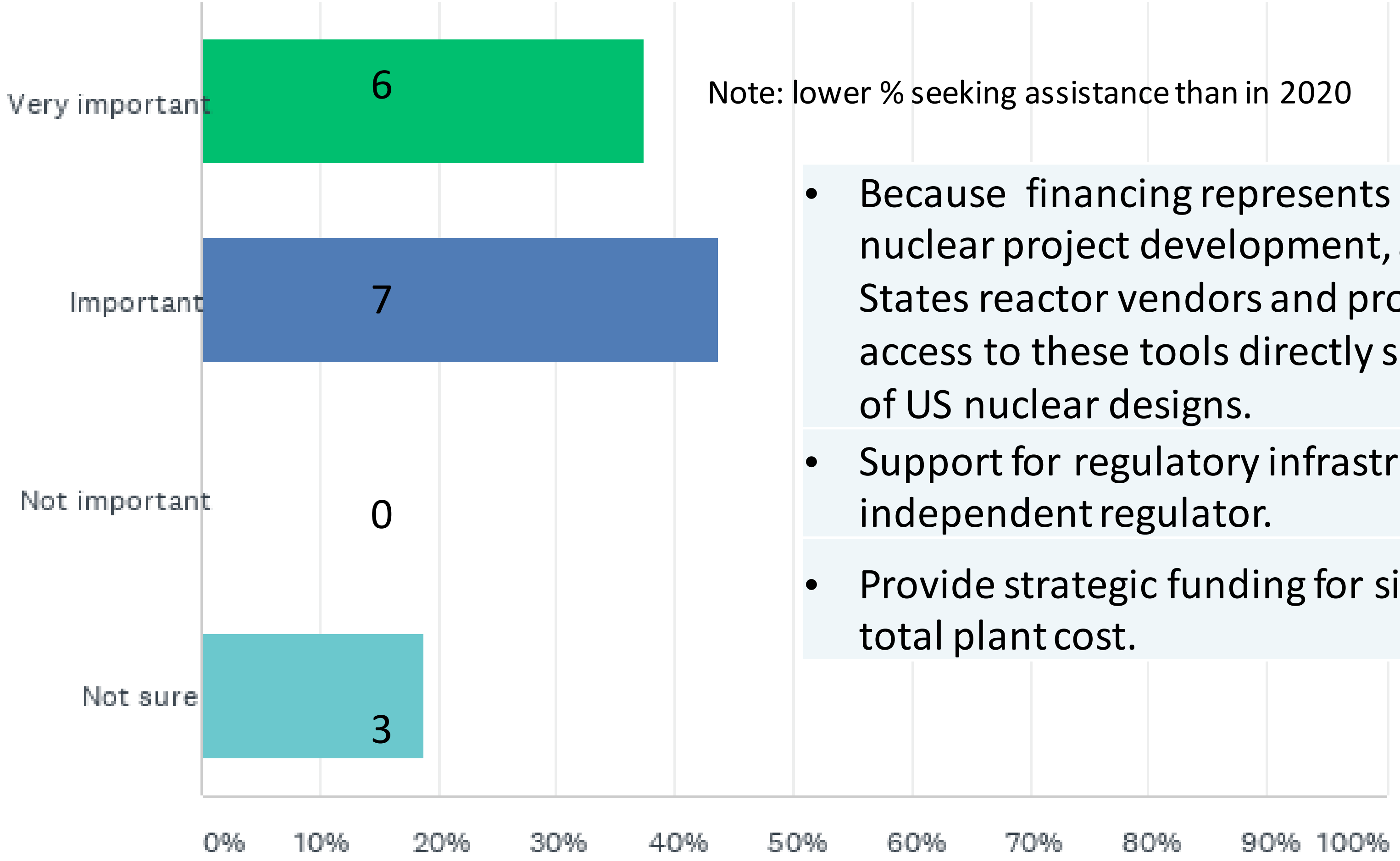
Q30: If you are seeking to export your design, would debt and/or equity financing from International Development Finance Corporation be helpful for your project?



Note: lower % seeking IDFC financing than in 2020

- Developing and nations new to nuclear power need such financial support
- Any financing options will be considered.

Q31: What level of importance do you believe that the International Development Finance Corporation, World Bank, and other international financial institutions have in assisting on the export of North American advanced reactors?



Note: lower % seeking assistance than in 2020

- Because financing represents a powerful tool for nuclear project development, ability for the United States reactor vendors and project participants to have access to these tools directly supports competitiveness of US nuclear designs.
- Support for regulatory infrastructure and financing of independent regulator.
- Provide strategic funding for significant portion of the total plant cost.

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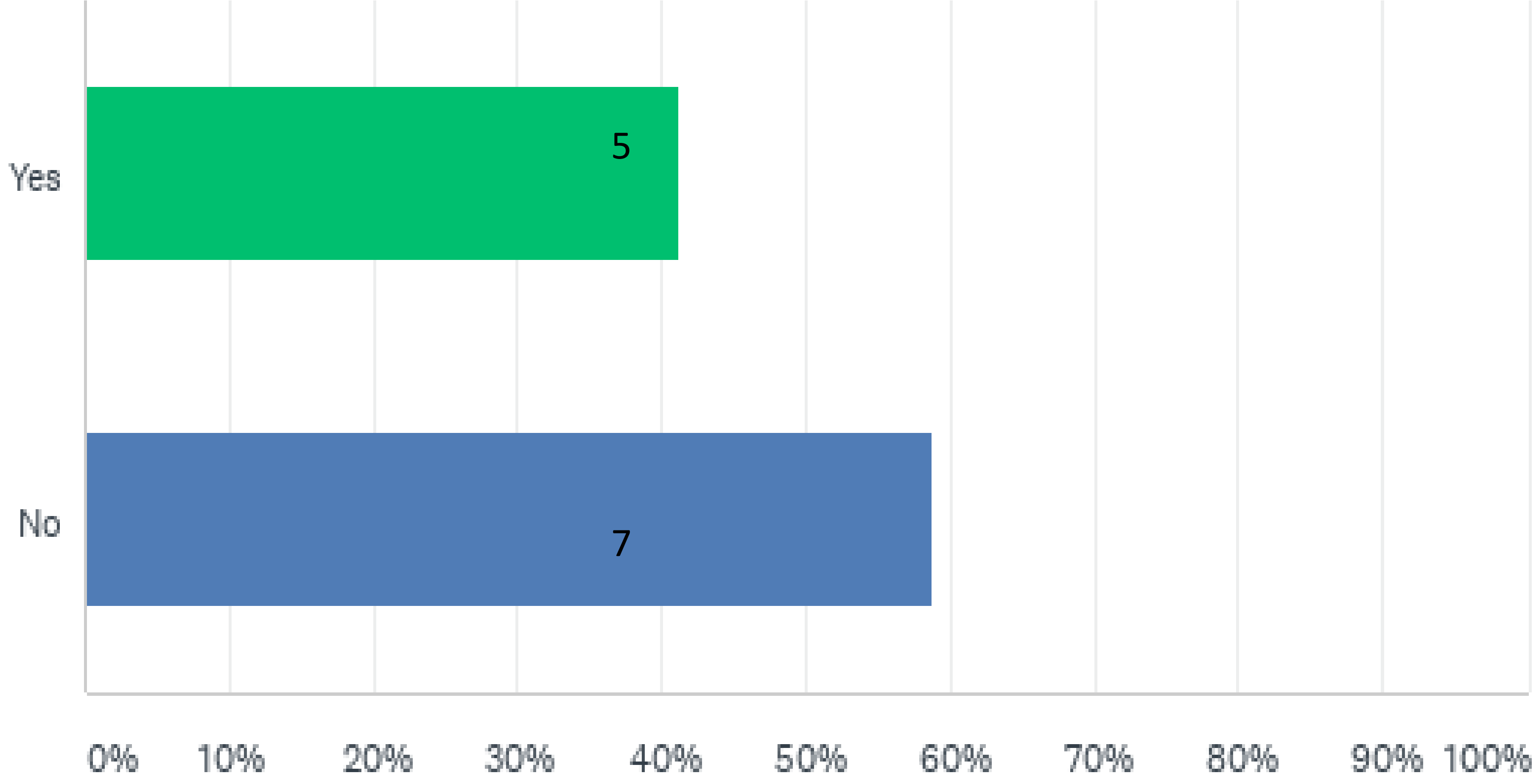
Q32: How useful is the U.S. Department of Commerce's efforts to facilitate reactor exports?



Comments on next slide

Q32: How useful is the U.S. Department of Commerce's efforts to facilitate reactor exports? – additional actions should Commerce be taking

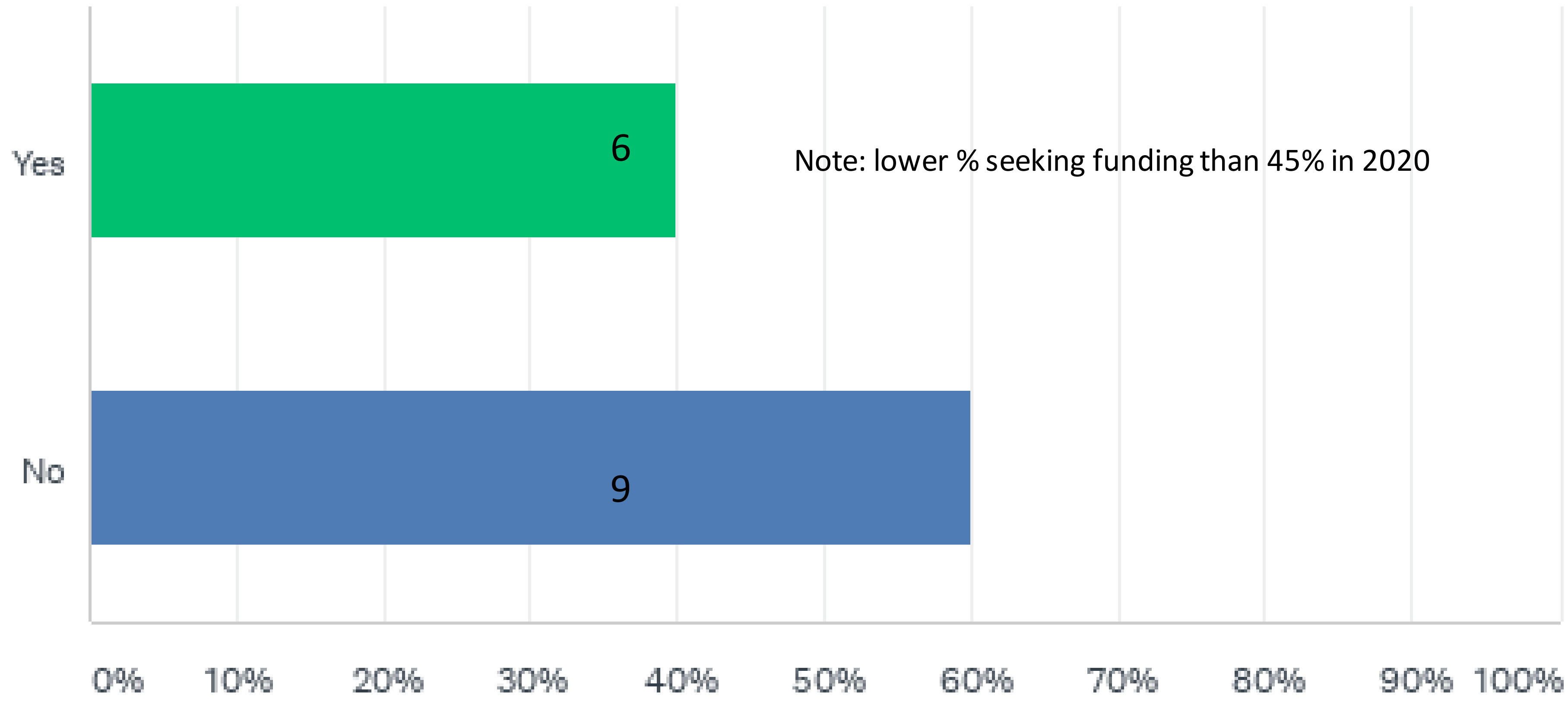
- Past opportunities with Department of Commerce have been beneficial in generating prospective market interest
- Very useful-- Any time the USG can advocate on behalf of US companies is a good thing
- Current actions being taken are useful
- Useful to facilitate conversations between countries; they also should host forums for vendor-to-vendor communication to facilitate international supply chain conversations
- Commerce is trying but not forceful enough-- need to be in advocacy role, not bystander role
- Marginally useful; their efforts appear useful but absent an approach that matches (or balances) the state support from other countries, they come across primarily as a matchmaker.
- Uncertain
- Once designs mature, greater involvement of AR developers at general conference
- For a reactor that provides decentralized energy, Commerce efforts can be made to promote the solution to remote application such as small communities and remote mining
- Virtually useless so far-- "Team USA" is a travel and dining club; designate a lead agency and individual, assign them as the capture lead, then give them the appropriate incentives and tools to close a transaction for the strategic benefit of the United States

USNIC 2021 SURVEY TOPICS – DOE & HALEU

Policy Issues (Q1-Q3)
Part 53 (Q4-Q9)
Reactor Type, Licensing (Q10-Q12)
US/Canada (Q13-Q15)
EPZ, Operators, Refueling (Q16-Q20)
NRC Fees, EIS (Q21-Q23)
Capitol Hill/States (Q23-Q27)
International/Commerce (Q29-Q32)
DOE Programs (Q28; Q33-39)
HALEU (Q40)
Issues (Q42, Q41)

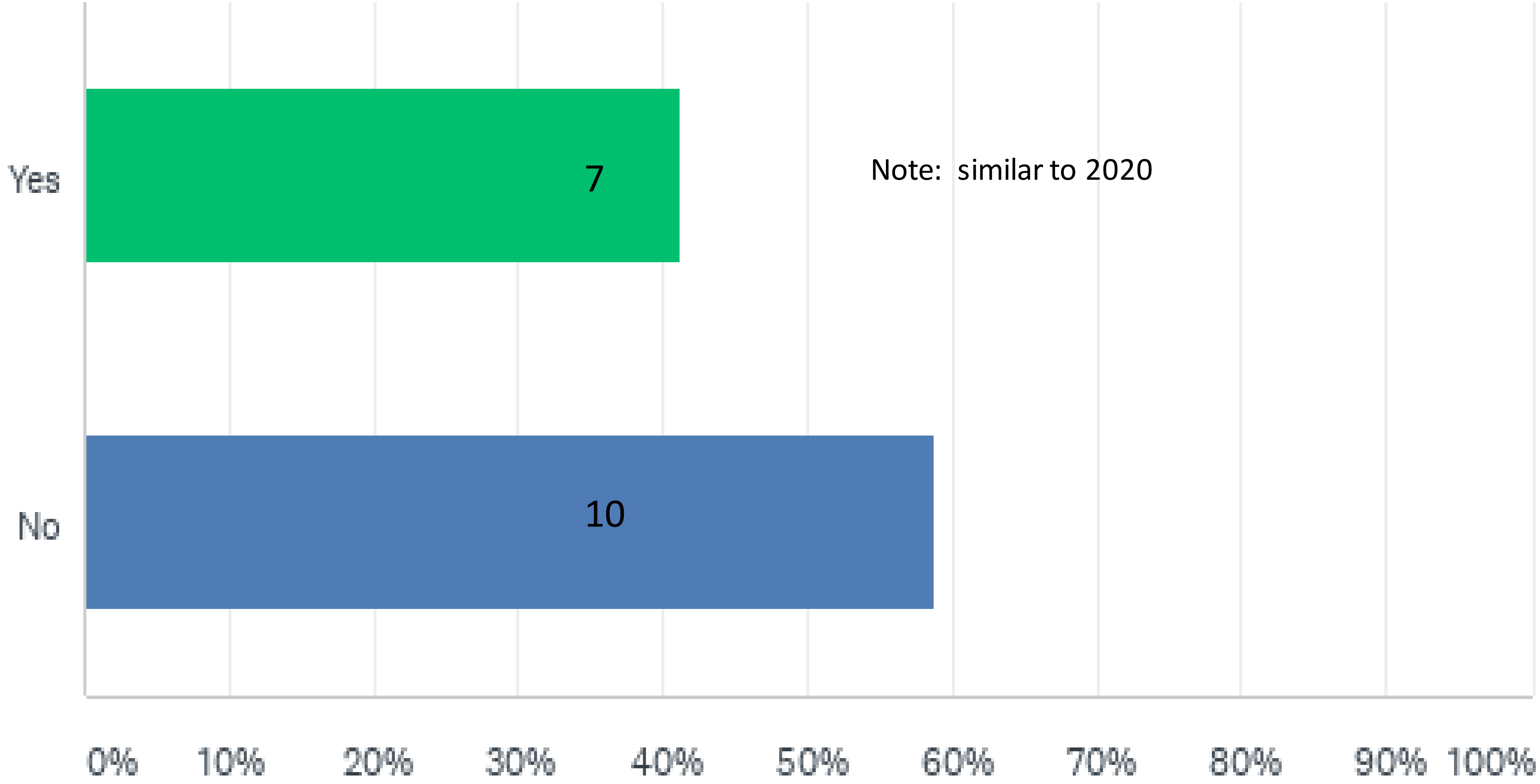
United States NIC Nuclear Industry Council

Q28: Do you plan to seek funding from DOE Loan Guarantee Program?



- Evaluating DOE LPO and planning to talk with prospective customers about DOE LPO as a financing option
- Perhaps, depending on terms and conditions
- Not in the short term-- possibly for factory build-out
- Operator owners of our reactor design will need loan guarantee
- Loan guarantee program provides a valuable tool for project financing
- Not needed

Q33: Was your company a recipient of the DOE GAIN (Gateway for Accelerated Innovation in Nuclear) program?



Note: similar to 2020

Q34: What are your views regarding the DOE GAIN program? (multiple answers allowed)

ANSWER CHOICES	RESPONSES	
Good for industry and your company	56.25%	9
Good for industry but not appropriate for your company	25.00%	4
Funding sufficient	6.25%	1
Funding insufficient	37.50%	6
Efficient for implementing policy	6.25%	1
Needs improvement	37.50%	6
Total Respondents: 16		

Note: higher % seeking improvement than in 2020

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Q34: What are your views regarding the DOE GAIN program? (additional comments)

- **Program biased to DOE Laboratory research interests vs applications that are more fundamental to bringing new reactors to market**.
- **Biased toward projects with the DOE labs; more science focused rather than paths to deployment of stronger designs.**
- GAIN approach should be broader and more fully funded.
- Needs to also be able to fund industry directly. Cost share required from industry is burdensome.
- GAIN provides legitimacy for work at national labs. The industry needs to do the work. National labs need to do basic R&D.
- Increase number of applications and vouchers per organization…suggest 3 active vouchers and 3 applications at a time.
- **The GAIN program is very good for jump-starting a program and getting access to the National Lab** complex. Our company has benefited greatly from the program. It could have better funding, and/or allow for more than 2 awards. The implementation (especially contracting) across the various labs is not consistent, and could benefit from some intermural lessons learned.

United States NIC Nuclear Industry Council

Q35: Do you plan on using the DOE Office of Nuclear Energy Funding Opportunity (FOA) Awards?

ANSWER CHOICES		RESPONSES	
Yes; have received award	Note: higher % have received award than in 2020	60.00%	9
Yes; have not received an award yet but hope to receive in the future		26.67%	4
No; do not expect to use this program		13.33%	2
TOTAL			15

- **DOE's contracting approach must be modernized**
- Entirely depends on the program function. Additional funding awards should consider 100% vouchers to be applied to labs even for partnerships-- current cost share awards do not allow for that. Additionally, DOE should consider milestone-based approaches (e.g., NASA COTS program), similar to the SpaceX funding awards where payouts were contingent upon achieving milestones.
- Our company has tried many times to receive an award, but every time DOE finds an excuse to not fund our company. We will continue to engage DOE.

More comments on next slide

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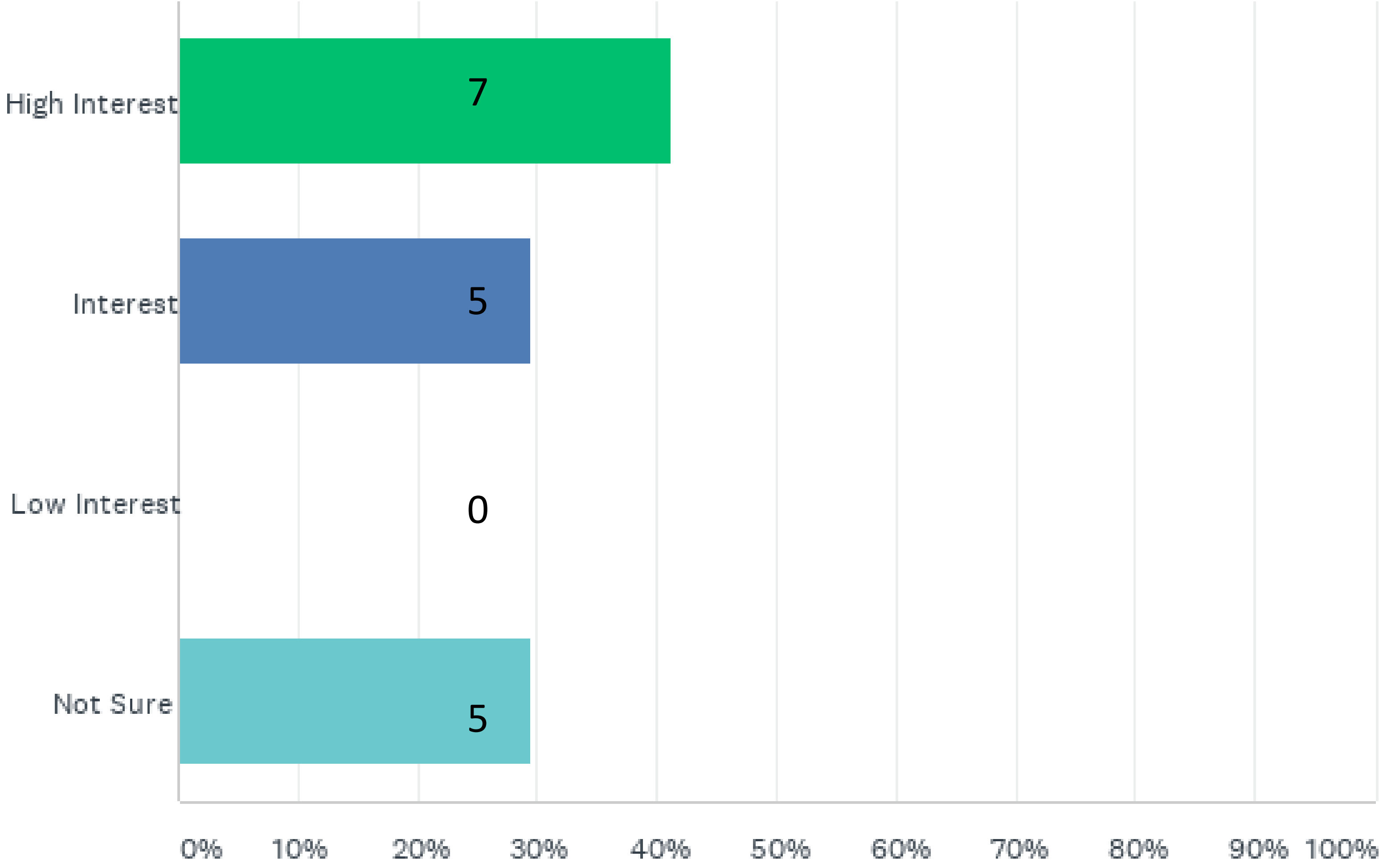
Q36: For people interested in FOA program, please provide your perspectives on the program (e.g., well managed, too complicated, insufficient $, insufficient awards)

- Opportunities have been value-added, and administrative requirements commensurate with the value-added
- Good. Well managed, spectrum of awards from deploy to R&D concept is good
- FOA funded projects have rarely led to commercial success
- Difficult to understand the selection process/criteria for the iFOA
- Overly burdensome administrative and labor intensive process
- Current FOAs are not well managed. Cost shares are ok, but could benefit from milestone-based approach (e.g., NASA COTS). Current payment structures cause unnecessary inflation in pricing, which is hugely detrimental to nuclear industry
- Insufficient # of awards
- Insufficient awards; awards not necessarily on merits of technology for timely deployment and do not recognize applications that provide path to near term deployment, vs. funding what amount to essentially "legacy" projects
- Way too complicated and expensive to administer-- Refer to NIA's "SpaceX for Nuclear" report
- Find a way to sustain the ARDP and ARC awards, but also provide ability to be directly funded via other RD&D funding opportunities
- If partial awards are granted in lieu of full awards, that creates additional friction in executing awards and adds administrative burden and uncertainty on fulfilling non-funded part; suggest more opportunity for discussion/negotiation/resubmittal if partial award is planned on being awarded
- Recommend more clarity on full program funding opportunity versus initial funding and more clear instructions related to submittal of costs; decrease timeline from award announcement to contract

Q37: Interest in using a milestone based program, that was authorized by the energy act, for current/future demonstration projects at DOE



Q38: What new DOE Office of Nuclear Energy initiatives are needed?

- Higher-confidence approach to **HALEU** supply
- Continued support for access to **HALEU** and spent fuel disposition and fuel/spent fuel transportation
- Defined program to build out commercial **HALEU** supply and deconversion to oxide
- **HALEU** fuel supply and back end used fuel management strategy; HALEU is progressing but back end infrastructure could become a deployment barrier
- **DOE should have more communication and coordination with the NRC in support of US initiatives**
- New materials development FOA-type with industry leadership
- Pick and stick with projects that actually show promise of near term demonstration and deployment
- Fund companies that have real track record in the nuclear industry
- Creating a funding opportunity for risk reduction awardees to proceed through demonstration
- TVA-like program to actually authorize, procure and build a government owned plant -- the SpaceX model
- New apolitical programs to drive clean energy research (including nuclear) without having to switch gears after changes in administration with a clear and targeted focus and goals (e.g. NIH)
- Contracting reform. “Real” milestone-based program, not one that actually increases the reporting/administrative burden

Q39: Any additional perspectives on how US or foreign governments are doing to support nuclear (that we can convey to them so they can consider improving their performance)?

- Significant support from UK government under its 10 point plan is supporting advanced technologies in the UK
- US needs to solve the political issues associated with used fuel; Recycling should be pursued, but near-term with surface storage
- Inclusion of nuclear in clean energy policy and support for efficiencies in the siting and regulation of nuclear projects
- US doing terrible job in the support for the operating fleet and advanced reactors. Foreign governments on the other hand seem to be gaining even more traction in supporting their domestic programs, as well as exports of nuclear technologies.
- Work harder with industry to clear regulatory hurdles
- Russia and China are eating our lunch; we need a durable policy (i.e., that will survive Administration changes) on how we will compete

Q40: If your design uses High-Assay Low-Enriched Uranium (HALEU) fuel, please provide answers for each question

How much do you need in next 10 years?	**Where do you plan to get it?**	**How do you plan to ship it?**
20 MT	First Tenex, then US sources	Tenex to ship
Insufficient design detail to confirm	Parent body	Appropriate containers
It depends on how many reactors we sell. Max 200 Tons	Commercial market place if demand is there. Can also produce it ourselves if the market demands it	Will design and license commercial HALEU shipping casks
Lab quantities in the short term, but core reload quantities ultimately. ~180+ MTHM steady state by 2035	US Strategic Reserve, weapons down-blending, or other commercial channels as available.	Likely in metallic form. Depends on regulations.
24MT	Russia (until US capability is established)	TBD
200-500 MT	DOE, domestically if available, internationally if necessary	Existing canister designs support transport
TBD	(1) DOE or (2) foreign suppliers if DOE cannot meet our needs	Existing transport packages
	DOE	
33,000 kg	DOE, Y12, Centrus, TENEX	Develop containers complying to 10CFR71 equivalent or IAEA Safety Standard SSR-6
TBD	US downblend or enrichment capability	TBD

Q40: If your design uses High-Assay Low-Enriched Uranium (HALEU) fuel, please provide answers for each question

(continued)

Where will you need it shipped to?	**How much are you budgeting for the cost of HALEU?**	**How do you plan to pay for it?**
US location	Private info	private investment plus demo match
UK	Insufficient detail to confirm	Confidential
Fuel factory to reactor site if enrichment facility is not near the fuel plant	Ultimately $500/lb	FOAK plant should be free from DOE; Then commercial market place rules
Undetermined at this point-- A fabrication facility.	TBD	USG grant for development quantities Commercial contracts for production quantities.
TBD	$100-$125mm	TBD
		Private funding and customers
TBD		Private or where allowed, DOE programs
To TRISO manufacturers in US and then to Assembly facility in US or Canada	$8,000/kg U	DOE funding or from operations
TBD	TBD	TBD

Q40: If your design uses High-Assay Low-Enriched Uranium (HALEU) fuel, please provide answers for each question
(continued)

Is a U.S. Government HALEU fuel bank important?	**What non HALEU fuel do you plan to use, and how much to you need in the next 10 years?**
Yes	None
N/A	
Not enough for commercial use; Good for FOAK of a few plants	None
Yes-- It provides stability of prices and surety of supply	Not applicable to our design
Yes, if it serves as motivation to support US capability	Not applicable
Maybe, depends upon structure	
Yes	None
Yes	None
Yes	None
Yes	None

United States NIC Nuclear Industry Council

USNIC 2021 SURVEY TOPICS – Issues

Policy Issues (Q1-Q3)
Part 53 (Q4-Q9)
Reactor Type, Licensing (Q10-Q12)
US/Canada (Q13-Q15)
EPZ, Operators, Refueling (Q16-Q20)
NRC Fees, EIS (Q21-Q23)
Capitol Hill/States (Q23-Q27)
International/Commerce (Q29-Q32)
DOE Programs (Q28; Q33-39)
HALEU (Q40)
Issues (Q42, Q41, Concluding Insights)

Q42: Additional comments
(not provided in response to other questions)

- **Revisit role of ACRS**-- ACRS scope is broad and allows them to interject on nearly any licensing action. Role should be revised to be more constructive, rather than simply performing a redundant independent review already performed by the NRC staff
- Reliable (DOE) funding over long time periods
- Sufficient NRC review resources
- Certain statutory requirements in the AEA provide limitations in the area of security requirements (e.g., force-on force exercises, fingerprint collection, federal background checks) that may not be appropriate or necessary given the current environment or proposed operational programs for advanced reactors.

Q41: What issues keep you up at night?

(multiple answers allowed)

Rank	Issue	Score	# of companies	2020
1	**Availability of High Assay Low-Enriched Uranium**	**65%**	**11**	**#1**
2	**Ability to sell initial 10-20 commercial units (beyond initial demo unit)**	**53%**	**9**	**#2**
3tie	**Current NRC reactor licensing process (other than Part 53)**	**47%**	**8**	#7
3tie	**Sufficient government funding for the development of advanced reactor technologies**	**47%**	**8**	#3
3tie	**Availability of financing for domestic deployment**	**47%**	**8**	#4
6tie	**Administration change (in 4-8 years) to one that is not supportive of nuclear**	**29%**	**5**	#5
6tie	**Availability of financing for international deployment**	**29%**	**5**	#6
6tie	**Sufficient domestic manufacturing resources to produce your design**	**29%**	**5**	
9	**Potential requirements for safeguards and security**	**24%**	**4**	
10	**Part 53 (based on NRC current language)**	**18%**	**3**	
Other	**Clear waste disposition policy, sufficient federal resources, etc.**		---	
			17	

United States NIC Nuclear Industry Council

Concluding High Level Insights (1 of 2)

- Action needed to provide **multi-decade U.S availability of High Assay Low-Enriched Uranium (HALEU)** for advanced reactor deployment
- **Selling, financing, and deploying 10-20 commercial units** (after initial demos) is important for industry's health (and to prove advanced nuclear can substantially contribute to world's clean energy goals)
- Fuel qualification, fuel cycle (facilities, higher enrichment, transportation), PRA & operator staffing (for small & multi-modular facilities) need regulatory guidance
- Although over 90% think Part 53 is important/desirable for industry (rest would use Part 50 or 52 or take different approach), majority of developers are dissatisfied or very dissatisfied with usefulness of current Part 53

United States NIC Nuclear Industry Council

Concluding High Level Insights (2 of 2)

- Only 35% of companies currently plan on using significant PRA input
- 2/3 of companies plan on licensing in Canada and U.S., so harmonization and reciprocity is desirable
- When EPZ is applicable, all developers think appropriate EPZ is the site boundary
- Almost 20% of advanced reactor designs do not require control room operators
- U.S. government programs are important for international sales to compete against foreign national government sponsored competitors
- Ongoing U.S. government funding and incentives for advanced nuclear are important, as well as states & U.S. government including nuclear in their clean energy standards

U.S. Nuclear Industry Council 2021 Advanced Nuclear Survey

For questions contact

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United States NIC Nuclear Industry Council

Break

Meeting will resume at 1pm EST

Microsoft Teams Meeting
Bridgeline: 301-576-2978
Conference ID: 442 887 144#

Role and Use of PRA in Support of Advanced Reactor Licensing

Nathan Sanfilippo, Special Assistant
Marty Stutzke, Senior Level Advisor for PRA

Division of Advanced Reactors and Non-Power Production and Utilization Facilities
Office of Nuclear Reactor Regulation

August 26, 2021

Overview of the Graded PRA Initiative

How It Started

A Change in Direction

How It's Going

Next Steps

How It Started

- In the spring of 2021, a working group was formed to develop viable options to grade the PRA to conform to the preliminary Part 53 language that had been issued.
- The staff originally envisioned a three-phase process:

Phase 1 | Develop a graded PRA approach

Phase 2 | Craft guidance

Phase 3 | Explore alternatives to PRA

Working Definitions as of the Advanced Reactor Stakeholders Meeting Held 5/27/2021

Note: These definitions are quoted from our presentation in the May 27th Advanced Reactor Stakeholder Meeting Slide Package (please see Slide 47 of ML21146A347).

Graded PRA approach

- A process that uses bounding, conservative, and/or qualitative assessments to establish a PRA's scope, level of detail, degree of plant representation, and/or level of peer review commensurate with the licensing stage (which dictates the level of detail and finality of the information used to develop the PRA) and how the PRA will be used in risk-informed decision-making.

Graded PRA

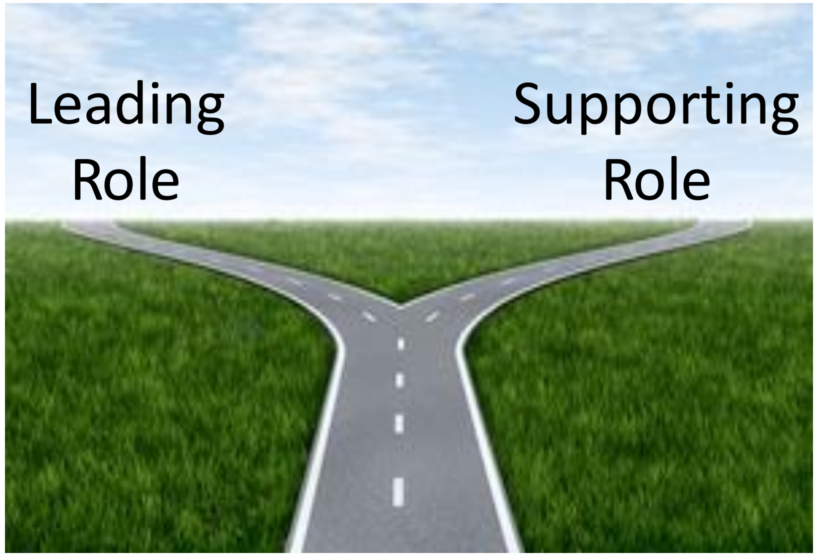
- A PRA of appropriate degree of scope, level of detail, plant representation, and technical adequacy to support a specific advanced reactor licensing application.
- Note: "Graded" should not imply that a design is not yet complete –acceptance of a graded PRA could only be considered if a design is well understood and conservatively modeled.

Dose/consequence-based criterion

- A potential entry condition to enable a graded PRA that uses bounding, conservative, and/or qualitative assessments of the doses or consequences arising from potential unplanned release scenarios, without consideration of the release scenario likelihood. This approach is being considered as a specific criterion for developing a graded PRA to adequately demonstrate that an applicant meets the intent of the Commission's Severe Accident Policy in an efficient and effective manner.

A Change in Direction

- Based on feedback during the Advanced Reactor Stakeholders public meeting held 5/27/2021, the staff learned that industry concerns were largely directed at grading how PRA was used in the licensing process, rather than grading the technical content of the PRA itself.
- There was general recognition from industry that the NLWR PRA standard already offers opportunities to grade the content of the PRA.

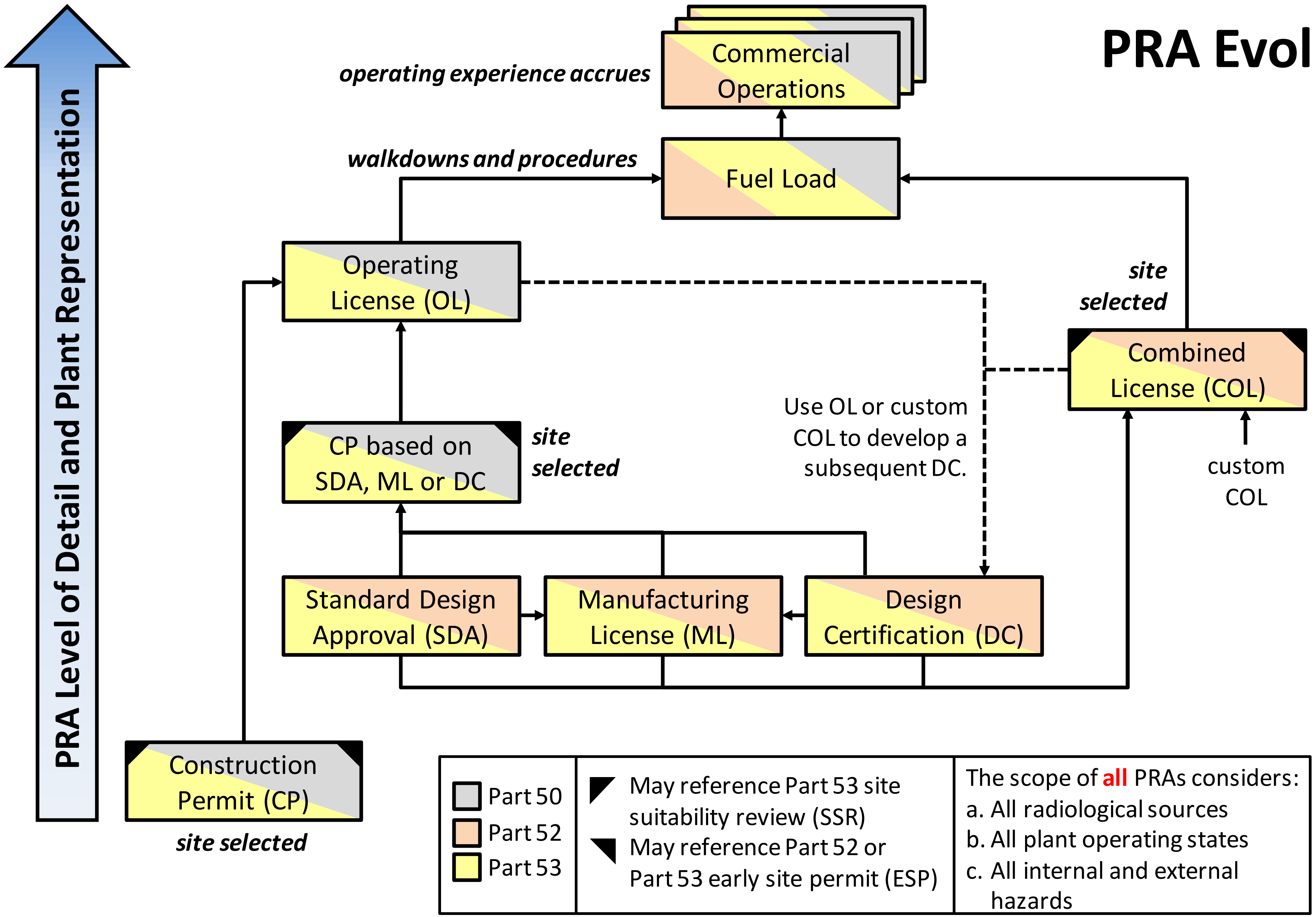


How will the PRA be used in the licensing process?

How It's Going

- Since that time, the staff has further explored the scope of the PRA and how it is used in licensing.
- Significant effort has been invested in thoroughly understanding:
  – The uses and role of the PRA in the licensing process,
  – Whether those uses and role could be adequately addressed with other tools/techniques/bounding assessments, and
  – How that information fits into the overall approach to licensing under Part 50, Part 52, and preliminary Part 53.

PRA Evolution



The Staff Is Considering Three Approaches to Safety Analyses

The Dose-Based Deterministic Approach

- Use of bounding analyses (e.g., MHA) and alternatives to PRA to a craft a deterministic safety analysis for reactors that meet an extremely low dose/consequence-based criterion.

The Traditional PRA Approach

- Use of a PRA to support/confirm a more deterministic safety analysis (e.g., current Part 52 approach, use of IAEA Specific Safety Requirements SSR-2/1 approach, etc.).

The Enhanced PRA Approach

- Use of a PRA in a leading role in the safety analysis (e.g., the LMP approach and preliminary Part 53 as currently envisioned).

Uses of the PRA in the Licensing Process

Enhanced PRA Approach (leading role)

- All uses in traditional PRA approach

AND

- Licensing basis event (LBE) selection
- System, structure, and component (SSC) classification
- Defense-in-depth (DID) evaluation
- Facility Safety Program (FSP)
- Other uses from Part 53

Traditional PRA Approach (supporting/confirmatory role)

- Demonstrate that quantitative health objectives (QHOs) are met
- Search for severe accident vulnerabilities
- Support severe accident mitigation design alternatives (SAMDA) analysis
- Other uses per Standard Review Plan (SRP) 19.0, such as:
  - Design reliability assurance program (D-RAP)
  - Inspections, tests, analyses, and acceptance criteria (ITAACs)
  - Combined License (COL) Action Items
- Voluntary risk-informed applications
- Periodic PRA maintenance/upgrade

Dose-Based Deterministic Approach

- Bounding or conservative analysis to demonstrate that QHOs are met
- Qualitative methods to search for severe accident vulnerabilities
- No risk-informed applications
- Maintenance/upgrade requirement

Potential Alternatives to PRA for Conducting a Systematic and Comprehensive Vulnerability Search

- Master logic diagram (MLD)
- Event sequence diagram (ESD)
- Integrated safety assessment (ISA)
- Process hazard analysis (PHA)
- Checklist
- What-if analysis
- Checklist/what-if analysis
- Hazard and operability analysis (HazOp)
- Failure modes and effects analysis (FMEA)
- Failure modes, effects, and criticality analysis (FMECA)
- Layers of protection analysis (LOPA)
- Etc., etc.

- ***Use a combination of methods***
- ***Guidance needs to be developed***

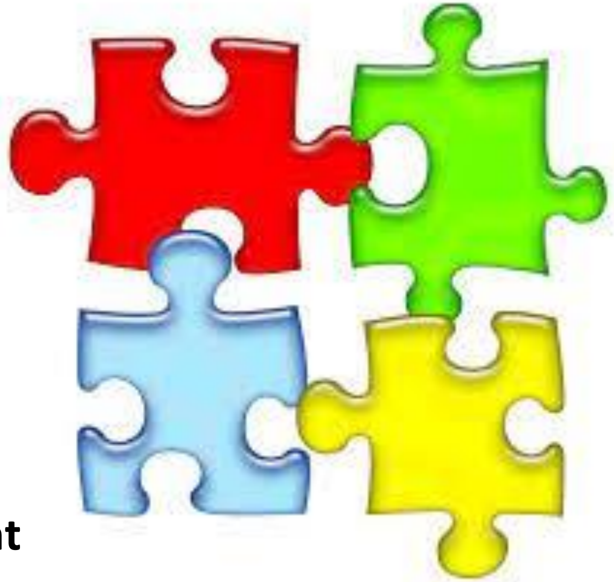
Potential Entry Conditions for the Dose-Based Deterministic Approach

- Dose/consequence considerations
- Reactor thermal power
- Design incorporates one or more of the attributes identified in the Commission’s Advanced Reactor Policy Statement (73 FR 60612; October 14, 2008)

Next Steps

Continue investigating entry conditions for the Dose-Based Deterministic Approach

Seek guidance from additional Agency expertise



Establish RES project to identify and evaluate qualitative methods for systematic and comprehensive vulnerability search

Identify and resolve policy issues:

- **Advanced Reactor Policy Statement**
- **PRA Policy Statement**
- **Safety Goal Policy Statement**
- **Severe Accident Policy Statement**
- **Authority under Nuclear Energy and Innovation Modernization Act (NEIMA)**

Coordinate with rulemaking activities:

- **Part 53 (NRC-2019-0062; RIN 3150-AK31)**
- **Part 52 Lesson Learned (NRC-2009-0196; RIN 3150-AI66)**

Part 53 Rulemaking: Role of the PRA

Marc Nichol
Senior Director, New Reactors

August 26, 2021

NUCLEAR ENERGY INSTITUTE

Unified Industry Position on Part 53 Letter

Industry perspectives relevant to Role of PRA

- Usefulness
  - All licensing approaches are viable
  - Less burdensome over the lifecycle of activities
  - Guidance will be important to explain how to meet the regulation
- Risk-Informed
  - NRC PRA policy statement: use of PRA to the extent it is practical
  - Primary expectation is that decisions are informed by the use of a PRA
  - In some cases alternatives to a PRA may provide equivalent benefits
  - Part 53 should allow a variety of roles and uses of the PRA
  - Allow for both “leading” and “confirmatory/supporting” roles

Flexibility on the Role of PRA

- Role of the PRA has been one of industry's greatest concerns
  - Must allow for both "leading" and "confirmatory" roles
  - Range of mix of deterministic and PRA
- A "confirmatory" option is important
  - Not everyone will pursue a "leading role"
  - NRC prior approval of "confirmatory role" as sufficient to meet Policy Statement

Accomplishing Risk-informing

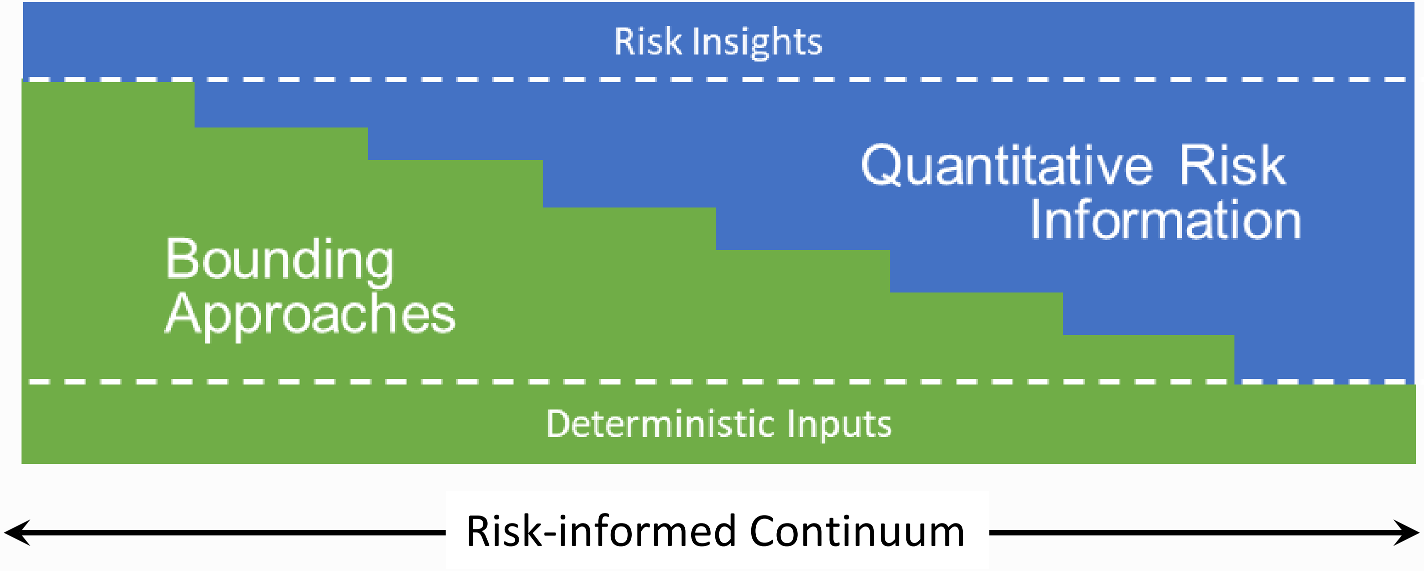
Deterministic Criteria + Risk Information = Risk-Informed

Risk Information + Deterministic Criteria = Risk-Informed

Benefits of Risk-informing

- Integrated approach of PRA complements deterministic
- Characterize the overall residual risks of a design
- Can help focus on issues of safety significance
- Should yield greater operational flexibility after licensing

Spectrum of Risk-informed Approaches



NEI Paper

“Technology-Inclusive, Performance-Based and Risk-Informed Approaches for Assessing the Safety Adequacy of the Design for Part 53”

- Goals:
  - Advance discussion of how different approaches may fit under Part 53
  - More clearly illuminate the role of PRA and risk information
- Approach:
  - Establish a flexible framework of principles for a sufficient safety case
  - Build on elements of a TI-RIPB process for assessing safety adequacy
  - Present four examples across the spectrum of potential approaches
  - Demonstrate how each example meets the guiding principles
  - Each example has a different balance between deterministic safety analyses and risk information in what is always a risk-informed process

Key Elements of Part 53 Addressed

- Limits for protecting the public health and safety
- Safety functions
- Licensing basis events
- Defense-in-depth
- Design features
- Functional design criteria
- Safety categorization

Notes

- The paper does not imply an endorsement of the NRC preliminary rule text, but acknowledges that these key elements are important to the safety case
- Other Part 53 elements are important to the licensing basis, but are not included since they do not have a primary effect on the TI-RIPB process
- It is envisioned that the TI-RIPB process in the paper will inform future changes to the Part 53 requirements

Principles for TI-RIPB Process

1. The plant meets the established limits for the adequate protection of the public health and safety.
2. The safety functions, design features and functional design criteria relied upon to meet the safety criteria are established.
3. The selected LBEs adequately cover the range of hazards that a specific design is exposed to.
4. The SSCs are categorized according to their safety significance.
5. The design reflects the application of an appropriate philosophy of defense-in-depth.
6. The special treatment for SSCs, and associated programmatic controls and human actions, provide reasonable assurance that the SSCs will perform the safety functions for which they are relied upon. *(Not addressed at this time)*
7. The scope and level of detail for the design and analysis of the plant in the licensing basis information adequately describes the safety case. *(Not addressed at this time)*

Example A: NEI 18-04 (Leading Role)

TI-RIPB Principle	Approach to Meet Principle in Example A
1. Meet established limits for adequate protection	• PRA frequencies and consequences ensure LBEs are within the F-C curve, and QHOs are not challenged • Deterministic safety analyses for DBAs validate safety case made by PRA
2. Establish the safety functions, design features and functional design criteria	PRA delineates the relevant safety functions, which define safety features, which are used to select functional design criteria for each type of LBE
3. Selected LBEs adequately cover the range of hazards	• PRA is the primary component of an iterative process to select the LBEs in a systematic and comprehensive manner • Deterministic methods are used to support the iterative process to select LBEs based on the PRA
4. SSCs are categorized according to their safety significance	PRA is used to categorize SSCs according to the roles they play in satisfying the safety functions
5. Design reflects the application of an appropriate philosophy of defense-in-depth	PRA is used to establish DID through systematic evaluation of LBEs, with systematic determinations of adequacy, including the need to account for uncertainties

Example B: NEI 18-04 (Confirmatory Role)

TI-RIPB Principle	Approach to Meet Principle in Example B
1. Meet established limits for adequate protection	• Deterministic analyses determine the limits are met • PRA confirms F-C curve and the QHOs are not challenged
2. Establish the safety functions, design features and functional design criteria	• Deterministic analyses establish safety functions, safety features and functional design criteria (e.g., use of ARDC) • PRA confirms or identifies vulnerabilities to address
3. Selected LBEs adequately cover the range of hazards	• Deterministic methods are primary component of iterative and systematic process to select the LBEs • PRA supports deterministic methods in iterative process
4. SSCs are categorized according to their safety significance	• Deterministic methods used to categorize SSCs according to the roles they play in the DBA analysis • PRA determines additional SSCs with special treatment
5. Design reflects the application of an appropriate philosophy of defense-in-depth	• Deterministic methods systematically establish DID and adequacy, including the accounting for uncertainties • PRA confirms or adjusts DID to establish adequacy

Example C: IAEA

TI-RIPB Principle	Approach to Meet Principle in Example C
1. Meet established limits for adequate protection	• Deterministic analyses determine the limits are met • PRA searches for cliff-edge effects, and can be used to confirm F-C curve and the QHOs are not challenged
2. Establish the safety functions, design features and functional design criteria	• Deterministic assessments and requirements establish safety functions, “principal technical requirements” and design requirements (equivalent to NRC) • PRA at discretion/member state requirements to confirm
3. Selected LBEs adequately cover the range of hazards	• Deterministic methods establish LBEs (Normal, AOO, DBA, and BDBE) • PRA informs through perspective on the frequencies
4. SSCs are categorized according to their safety significance	• Deterministic assessments are primary means of categorizing SSCs and are informed by PRA insights
5. Design reflects the application of an appropriate philosophy of defense-in-depth	• Deterministic framework of five levels of DID • PRA results provide further assurance of DID adequacy

Example D: Bounding Analysis

TI-RIPB Principle	Approach to Meet Principle in Example B
1. Meet established limits for adequate protection	• Deterministic analyses determine the limits are met • Risk information* provides perspective on the margin and demonstrates that the QHOs are not challenged
2. Establish the safety functions, design features and functional design criteria	• Deterministic analyses establish safety functions, safety features and functional design criteria (e.g., use of ARDC)
3. Selected LBEs adequately cover the range of hazards	• Deterministic methods identify and confirm adequacy of events (one or small set) with bounding consequences • Risk information in limited role confirm events are bounding
4. SSCs are categorized according to their safety significance	• Deterministic assessments conservatively categorize SSCs • Risk information at discretion to reduce conservatism and address non-safety SSCs
5. Design reflects the application of an appropriate philosophy of defense-in-depth	• Deterministic methods systematically and conservatively establish DID and adequacy • Risk information may be used to inform process

*Risk information may be from a simplified PRA, or alternative conservative and simpler systematic risk assessment approach.

Next Steps

- NEI White Paper on “TIRIPB Approaches for Development of Licensing Bases for Part 53”
  - Send for NRC review early to mid September (expected)
- NRC feedback
  - Confirmation that the safety framework in the paper (i.e., guiding principles) is appropriate for Part 53
  - Agreement that examples in the paper sufficiently implement the safety framework
  - Whether more detail about the principles or examples is needed in order to inform Part 53 requirements

Advanced Reactor Stakeholder Meeting

Status of Regulatory Guide Endorsing the Advanced Non-LWR PRA Standard

U.S. Nuclear Regulatory Commission
August 26, 2021

Development of Regulatory Guidance on PRA Acceptability for NLWRs

- Consistent with current regulatory principles for LWR PRA acceptability
- Supports Licensing Modernization Project implementation
- Provide staff position and endorsement in a trial use Regulatory Guide
  - Stakeholders can use the trial use RG as a basis for preparing near-term initial licensing applications.
  - No public comment period before issuance. Trial use period is the public comment period for final Reg Guide.
- Draft white paper issued January 15, 2021 (ML21015A434). Issues not addressed in RG 1.247 will be included in later documents.
- Timing:
  - Support near-term applicants
  - Promote long-term regulatory stability

Documents to be endorsed

- In February 2021, ASME and ANS jointly issued ASME/ANS RA-S-1.4-2021, "Probabilistic Risk Assessment Standard for Advanced Non- Light Water Reactor Nuclear Power Plants"

- In May 2021, NEI submitted NEI 20-09, Rev. 1, Performance of PRA Peer Reviews Using the ASME/ANS Advanced Non-LWR PRA Standard
  - Initially submitted May 2020.
  - Public meetings held July, October and December 2020.

RG 1.247 - ACCEPTABILITY OF PROBABILISTIC RISK ASSESSMENT RESULTS FOR ADVANCED NON-LIGHT WATER REACTOR RISK-INFORMED ACTIVITIES

- Structure is similar to RG 1.200 – An Approach for Determining the Technical Adequacy of PRA Results for Risk-Informed Activities
- Draft provided to ACRS to support September 20, 2021, Subcommittee meeting. Will be public prior to September 20.
- No formal solicitation of comments for a trial use Reg Guide. Public meeting to be planned for October 2021.

Schedule

Milestone	Activity
February 2021	JCNRM publishes ASME/ANS RA-S-1.4-2021
May 2021	NEI formally submits peer review guidance NEI 20-09
August 2021	RG technically complete; start RG publication process
September 20, 2021	ACRS subcommittee meeting
October 2021	Public meeting to discuss draft trial use RG
December 2021	RG issued for trial use
TBD	Revise trial-use RG to incorporate lessons learned and revision to ASME/ANS RA-S-1.4 (anticipated in 2023-2024)

Stakeholder’s Meeting

Advanced Reactor Content of Application Project

Risk-Informed Inservice Inspection/
Inservice Testing Programs

Interim Staff Guidance

Background

- The Advanced Reactor Content of Application Project (ARCAP) has been developing guidance to support the review of non-LWRs, modular LWRs and stationary micro-reactors.

- The guidance has been developed in the form of draft Interim Staff Guidance (ISG) documents.

- One of those draft documents is the ISG on “Risk-Informed ISI/IST Programs” (ADAMS Accession No. ML21216A051)

- The purpose of this ISG is to facilitate the review of advanced reactor applications that use a risk-informed approach to develop or modify the scope of their ISI/IST programs.

Background (cont.)

- The guidance in this ISG can be applied to any non-LWR, small modular LWR or stationary micro-reactor applying for a CP, OL, COL, DC or ML under 10 CFR 50 or 52.
- The ISG guidance requires the use of risk information from a plant-specific PRA that is in conformance with an NRC endorsed PRA standard.
- The ISG guidance will be updated to apply to applications under Part 53, when Part 53 is issued.

Approach

- The ISG is divided into two parts:
  - Part 1 applies to LWRs
  - Part 2 applies to non-LWRs

- LWRs have existing requirements for ISI/IST program content and implementation in 10 CFR 50.55a, which are based upon NRC endorsed ASME Code requirements.

- LWRs also have existing guidance (RGs 1.175/1.178) that describe one acceptable way to make risk-informed changes to their ISI/IST programs.

- 10 CFR contains only general requirements (e.g., 50.34(b)(6)(iv)) related to non-LWR ISI/IST programs, although ASME has recently issued Section XI, Division 2, which NRC is reviewing for application to non-LWR ISI programs.

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Part 1 – LWRs

- LWR ISI requirements are listed in 10 CFR 50.55a and are based upon ASME Section XI, Division 1, "Rules for Inservice Inspection of Nuclear Power Plant Components".

- Guidance for making risk-informed changes to LWR ISI programs is given in RG 1.178 "An Approach for Plant-Specific Risk-Informed Decisionmaking for Inservice Inspection of Piping".

- LWR IST requirements are listed in 10 CFR 50.55a and are based upon the ASME "Operation and Maintenance of Nuclear Power Plants" Code (OM Code), Division 1.

- Guidance for making risk-informed changes to LWR IST programs is given in RG 1.175 "An Approach for Plant-Specific Risk-Informed Decisionmaking: Inservice Testing".

- For LWRs, a risk-informed approach to ISI/IST can be applied to all or only a portion of the program.

Part 1 – LWRs (cont.)

- Therefore, a framework for evaluating a risk-informed approach to LWR ISI/IST programs exists and is used in the ISG as the basis for the review guidance.

- The review guidance consists of the following major elements:
  - The baseline for evaluating risk-informed changes to ISI/IST programs are the requirements in 10 CFR 50.55a.
  - The plant-specific PRA must model the components included in the ISI/IST programs and must be used to assess the change in risk from the 10 CFR 50.55a baseline ISI/IST programs.
  - The acceptability of any risk-informed changes to the baseline ISI/IST programs is evaluated using the 4 principles in RGs 1.178 and 1,175:
    1. Maintaining defense-in-depth
    2. Maintaining safety margins
    3. Keeping any increase in risk small (using RG 1.174 criteria)
    4. Monitoring program effectiveness

Part 1 – LWRs (cont.)

- Key issues in reviewing LWR risk-informed changes to ISI/IST:
  - Advanced designs may utilize passive components to perform active safety functions. These components may not fall within the traditional IST program scope.
  - Therefore, applicants will need to propose (based on risk considerations) which of the passive components need to be included in the programs, what degradation mechanisms apply to the components, what inspection/testing techniques are capable of detecting the degradation, what are the appropriate inspection/testing frequencies and what are the acceptance criteria?
  - The review will also need to assess whether portions of the risk-informed ISI/IST programs are included in other programs (e.g., maintenance) and, if so, do the other programs adequately cover the risk-informed ISI/IST requirements?

Part 1 – LWRs (cont.)

- The review of risk-informed ISI/IST programs for LWRs include the following:
  - Is the PRA based upon an NRC endorsed PRA standard?
  - Does the PRA model the plant-specific components in the ISI/IST programs?
  - Have the programs been expanded to cover any passive components with active safety functions?
  - Are the inspection/testing techniques that differ from 10 CFR 50.55a requirements sufficient to detect the degradation?
  - Was the guidance in RG 1.175/178 used to determine the acceptability of changes to inspection/testing techniques and/or frequencies?
  - Are acceptance criteria defined for the inspection/testing that differs from 10 CFR 50.55a?
  - Is there a process defined for tracking any degradation and determining what actions, if any, are needed?
  - What QA applies to the programs?

Part 2 – Non-LWRs

- As stated previously, 10 CFR has only general requirements related to non-LWR ISI/IST programs.

- For non-LWR ISI, applicants are expected to use the risk information from their plant-specific PRA to identify the piping, reactor coolant boundary, pressure retaining and passive components and their supports to be included in the program, along with other components whose failure could prevent a safety function from being accomplished.

- For non-LWR IST, applicants are expected to use the risk information from their plant-specific PRA and associated design reviews to identify the active valves, pumps and dynamic restraint devices and the passive components with active safety functions to be included in the program.

- For non-LWRs, the ISG assumes that the ISI/IST programs will be risk-informed (i.e., no partial risk-informed programs).

Part 2 – Non-LWRs (cont.)

- For non-LWR ISI, the ISG is based upon the applicant using the requirements in ASME Section XI, Division 2, “Requirements for Reliability and Integrity Management (RIM) Programs for Nuclear Power Plants” (which is the subject of draft RG-1383).
- Section XI, Division 2, allows the applicant to develop an ISI program specific to the technology of the non-LWR design using expert panels and plant-specific risk information to:
  - Identify the components to be included in the program,
  - Develop reliability targets for the components in the program,
  - Identify the degradation mechanisms applicable to the materials and operating conditions of the design,
  - Identify inspection techniques (RIM strategies) applicable to the design,
  - Develop inspection frequencies for the components, and
  - Where the acceptance criteria in Appendix VII of Section XI, Div. 2, are not used, develop and justify acceptance criteria for the inspections.

Part 2 – Non-LWRs (cont.)

- For non-LWR IST, the ISG allows the applicant to develop an IST program specific to the technology of the non-LWR design. The program must be based on the risk information from the plant-specific PRA. The application needs to describe and justify:
  - How the components in the program were selected,
  - The specific testing to be performed for each component,
  - The frequency of testing for each component,
  - The reliability and performance targets for each component, and
  - The acceptance criteria for each test.

- The ISI/IST programs will also need to describe how trends in reliability and performance degradation are tracked and what actions are to be taken when degradation in performance or reliability is detected.

Part 2 – Non-LWRs (cont.)

- Key issues in reviewing non-LWR risk-informed ISI/IST programs:
  - As with advanced LWR designs, non-LWRs may rely more on passive components to perform active safety functions. Accordingly, applicants will need to develop and justify IST activities capable of assessing the operational readiness of those components.
  - Non-LWR designs will likely have limited data applicable to the degradation of material and component reliability and performance at the operating conditions of the design. This issue was addressed when new designs were being considered under 10 CFR 52. Regulatory Issue Summary (RIS) 2012-08 (Rev. 1), “Developing Inservice Testing and Inservice Inspection Programs Under 10 CFR Part 52”, July 17, 2013, provides useful information on how to address this issue.
  - Reliability targets and inspection/testing frequencies will need to be derived from the PRA.

Part 2 – Non-LWRs (cont.)

- The review of risk-informed ISI/IST programs for non-LWRs include the following:
  - Is the PRA based upon an NRC endorsed PRA standard?
  - Does the PRA model the plant specific components in the ISI/IST programs?
  - Are the degradation mechanisms of concern identified?
  - Are the proposed inspection/testing techniques capable of detecting the degradation of concern?
  - Are there acceptance criteria identified for each inspection/test?
  - Was risk information used to identify the components included in the program and their inspection/testing frequencies?
  - Is there a process for tracking trends in degradation and determining what actions, if any, are needed?
  - What QA applies to the programs?

NRC Preparations for Advanced Reactor Exports Follow-Up

Lauren Mayros

International Policy Analyst
Export Controls and Nonproliferation Branch
Office of International Programs

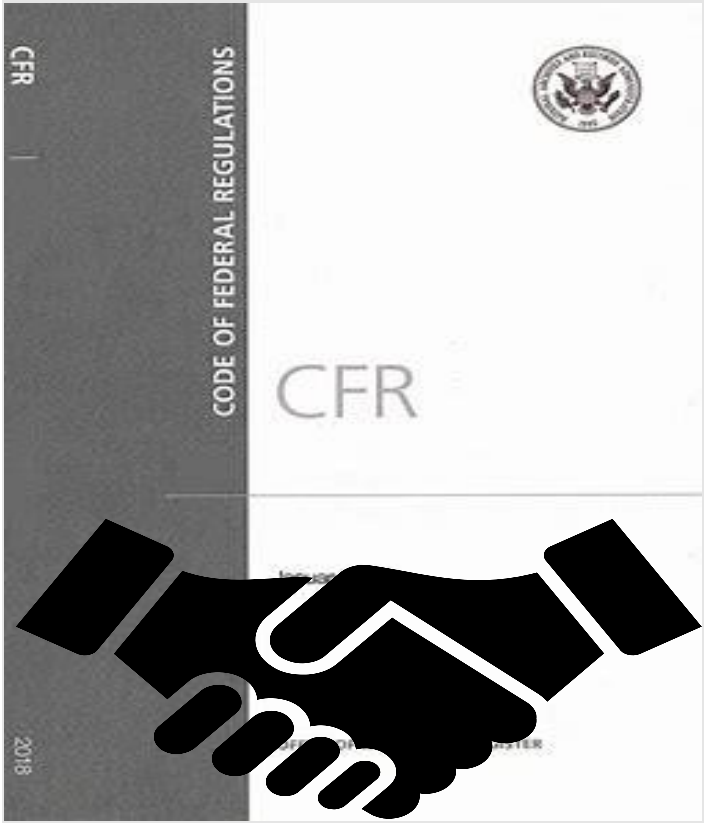
Periodic Advanced Reactor Stakeholder's Meeting
August 26, 2021

AREWG Purpose and Background

- Forward looking in the spirit of innovation and transformation.
- Keep pace with fast moving developments in the field of advanced reactors.
- Ensure that the NRC is prepared to license the export of these technologies in an independent, predictable and efficient way.

AREWG Mandate

- Evaluate NRC's readiness to complete exports (10 CFR 110) of "advanced reactors" to other countries consistent with NRC's Principles of Good Regulation (independence, openness, efficiency, clarity, and reliability).
- Assess if current level of review for advanced reactors is still appropriate.
- Conduct outreach to prospective vendors of advanced reactors on NRC's export licensing process.
- Develop a communication plan for future outreach.



Participants

- OIP
- OGC
- NMSS
- NSIR
- NRR
- RES
- Department of Energy/National Nuclear Security Administration
- Argonne National Laboratory

Design Types Studied

1) high temperature gas-cooled reactors
2) sodium fast reactors
3) fluoride salt-cooled high temperature reactors
4) molten salt reactors, including liquid fluoride salt and liquid chloride salt-cooled reactors
5) small heat pipe reactors.

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Conclusions and Recommendations

1. 10 CFR Part 110 is generally ready to license the materials and components associated with the 5 types of advanced reactor types studied.
2. Identified one advanced reactor system that is not clearly captured under Part 110 for export – the use of salt as a coolant.
3. Recommended several clarifying changes to Part 110 to remove any ambiguity that advanced reactors are covered under Part 110, i.e. fuel cladding other than Zirc. Tubes and salt.
4. Recommended working with the USG interagency to coordinate the recommended changes to Part 110 with the technical agenda of the NSG and conduct industry outreach on its conclusions.
5. Did not recommend changing the level of review for applications involving material and/or components for advanced reactors, i.e. Commission level review.

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Example of One Proposed Clarification

- Current Entry in 10 CFR Part 110, Appendix(6): "Zirconium tubes, i.e., zirconium metal and alloys in the form of tubes or assemblies of tubes especially designed or prepared for use as fuel cladding in a nuclear reactor."
- Proposed Clarification: "Cladding, i.e. any material especially designed or prepared for use as nuclear fuel cladding…"

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AREWG Public Report

Public Website

- https://www.nrc.gov/about-nrc/ip/us-nrc-prep-export-advanced-reactors.html
- https://www.nrc.gov/about-nrc/ip/export-import.html

ADAMS

- https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML21194A213

Hyperlink

- The Advanced Reactor Export Working Group Public Report

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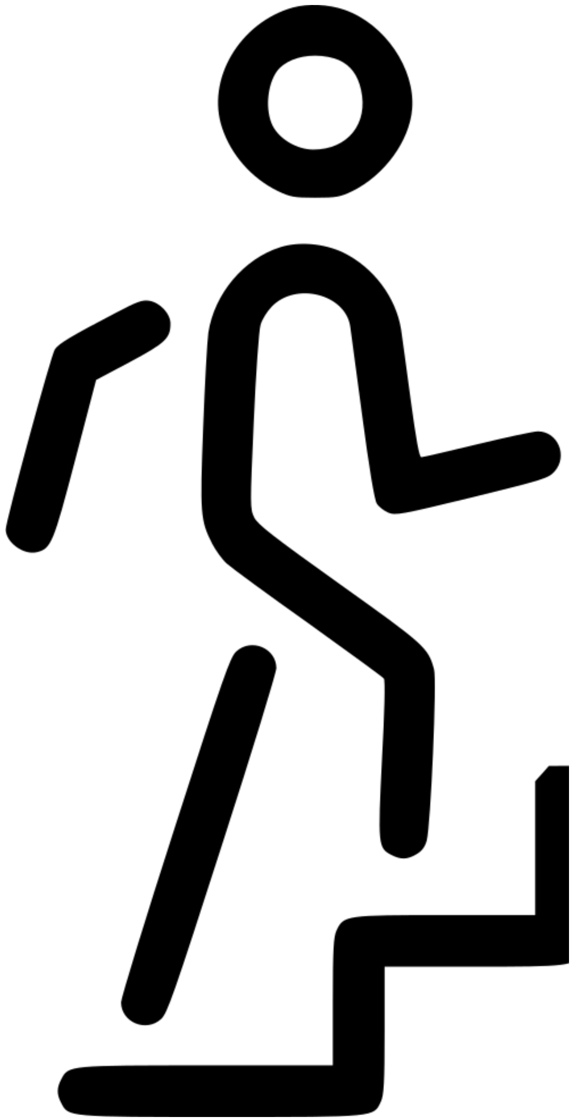

Next Steps

We want to hear from you!!

Would you prefer rulemaking or a reg guide to clarify the provisions for advanced reactor exports under Part 110?

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To contact the NRC Office of International Programs

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Thank You!

Any questions?

Future Meeting Planning

- The next periodic stakeholder meeting is scheduled for September 29, 2021.
- If you have suggested topics, please reach out to Margaret.O'Banion@nrc.gov

Advanced Reactor Program

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