



# **NRC Instrumentation and Controls (I&C) Regulatory Infrastructure for Reactors**

Updated December 2023

# Contents

**Slide 3** – NRC I&C Licensing Infrastructure

**Slide 4** – NRC I&C Staff Review Guidance

**Slide 5** – I&C Regulatory Infrastructure Technical Areas

- This slide identifies nine I&C technical areas (eight focused on Safety and one for Cyber Security)
- You can click on each of these nine technical areas and you'll be taken to the detailed regulatory infrastructure mapping for that specific technical area
- You can also click the link at the bottom that will take you to a slide that maps the eight Safety technical areas to the sections of ISG-06, "Licensing Process"

**Slides 6 to 14** – Detailed Regulatory Infrastructure Mapping for each Technical Area

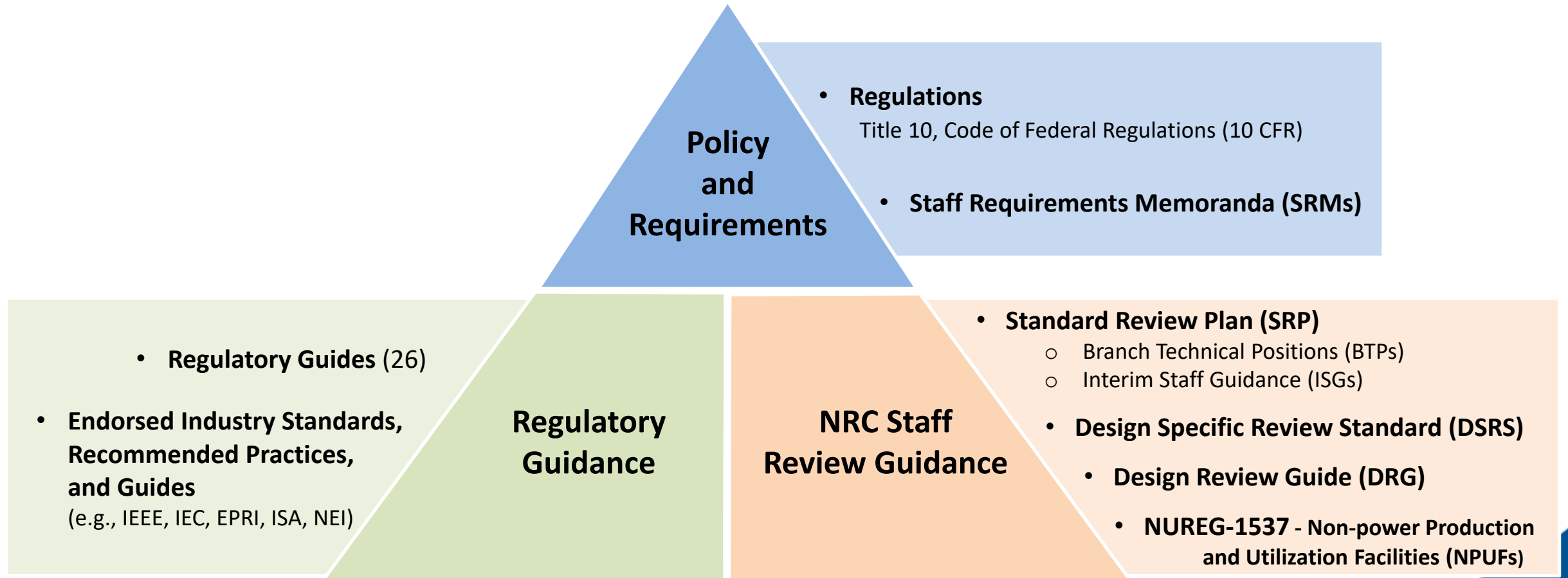
- Each of these slides covers the detailed regulatory infrastructure mapping for one of the nine technical areas identified in slide 5
- For each slide, the applicable regulatory requirements are on the left, the applicable regulatory guides and endorsed industry standards in the middle, and the staff review guidance is on the right
- You can click on the "Back" button to go back to slide 5

**Slide 15** – Mapping of I&C Technical Areas to ISG-06, "Licensing Process"

**Slide 16** – References

**Slide 17** – Acronyms

# NRC I&C Licensing Infrastructure



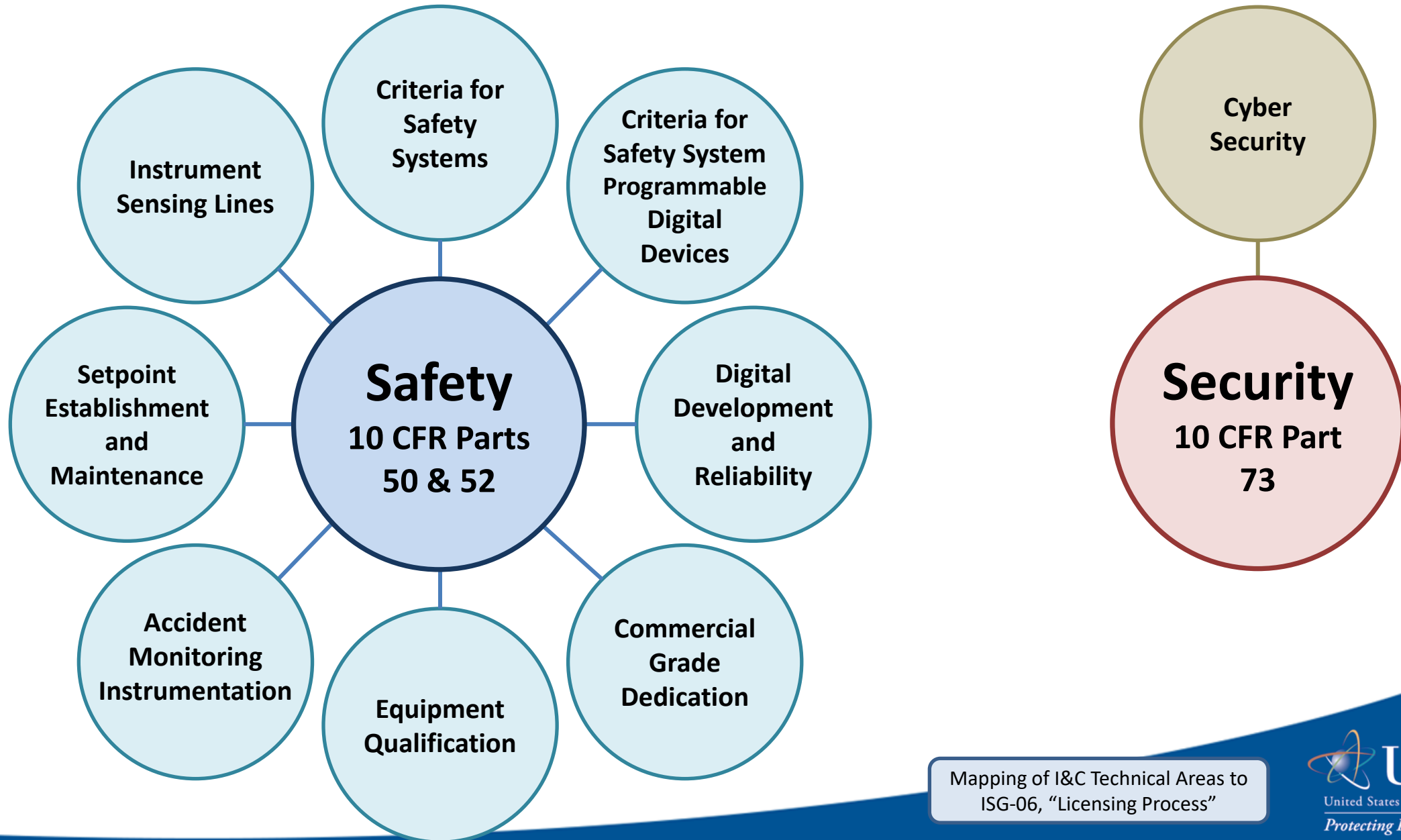
# NRC I&C Staff Review Guidance

## NRC Staff Review Guidance

- **Standard Review Plan (SRP)**
  - Branch Technical Positions (BTPs)
  - Interim Staff Guidance (ISGs)
- **Design Specific Review Standard (DSRS)**
  - **Design Review Guide (DRG)**
  - **NUREG-1537 - Non-power Production and Utilization Facilities (NPUFs)**

Document	Description
<a href="#">SRP Chapter 7, BTPs, ISGs</a>	Licensing review guidance for Light Water Reactors (LWR)
<a href="#">DSRS Chapter 7</a>	Design specific review standard (e.g., NuScale)
<a href="#">DRG</a>	Generic licensing review guidance for non-LWR reactors
<a href="#">NUREG-1537</a>	Licensing review guidance for NPUFs

# I&C Regulatory Infrastructure Technical Areas



Mapping of I&C Technical Areas to  
ISG-06, "Licensing Process"

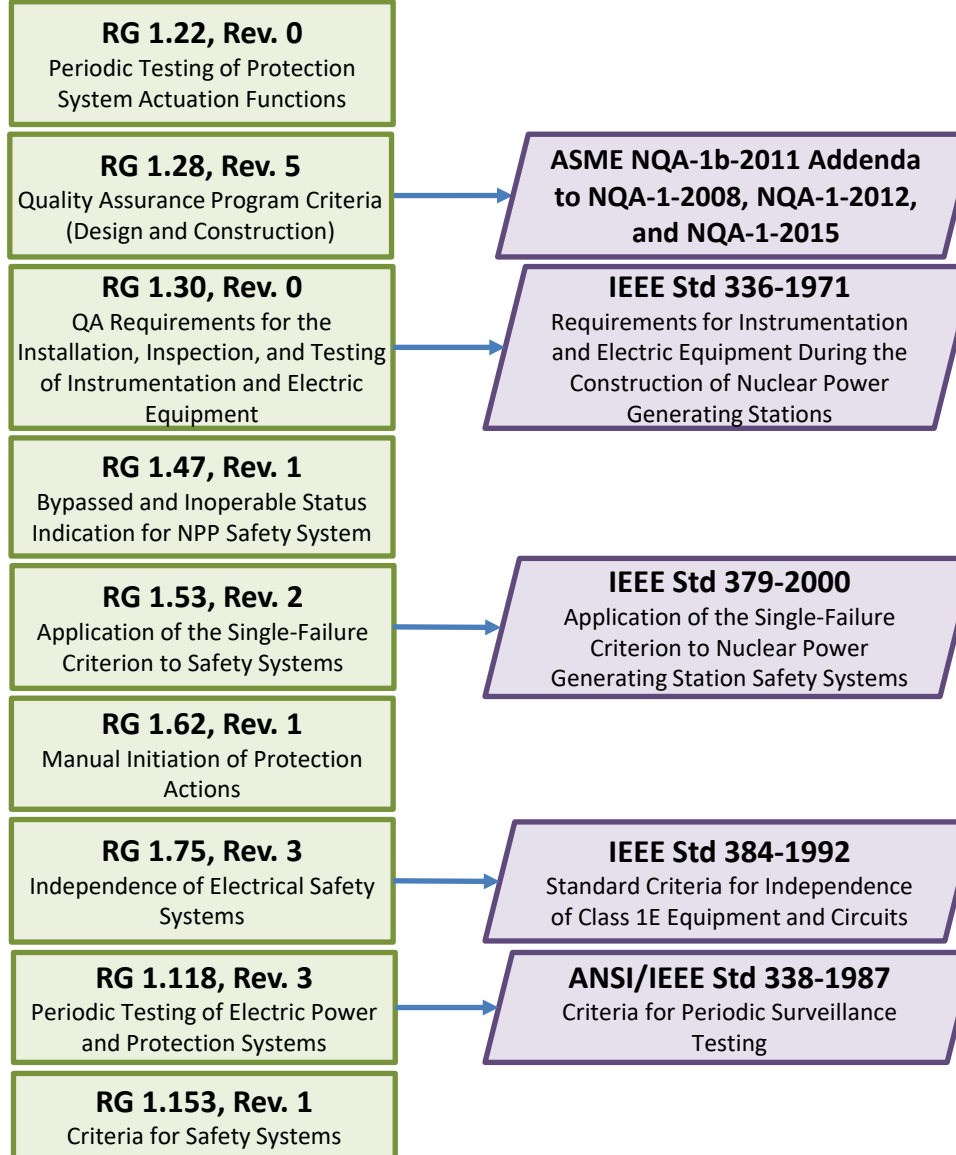
# Criteria for Safety Systems

## Regulatory Requirements & Policy

## Criteria for Safety Systems

- 10 CFR Part 50**  
Construction Permit (CP),  
Operating License (OL)
- 10 CFR Part 52**  
Design Certification (DC),  
Combined Operating  
License (COL), Standard  
Design Approval (SDA),  
Manufacturing License (ML)
- 10 CFR Part 50,  
Appendix A**  
General Design Criteria  
1,2,4,13,19,  
20,21,22,24,25,29,34
- 10 CFR Part 50,  
Appendix B**  
Quality Assurance Criteria
- 50.55a(h)**  
IEEE Std 603-1991  
IEEE Std 279-1971
- SRM-SECY-22-0076,  
SRM-SECY-93-087 \***  
Item 18

## Regulatory Guidance



## Staff Guidance

- NUREG-0800**  
Standard Review Plan, Chapter 7 – I&C  
7.1 – Introduction,  
7.2 - Reactor Trip System,  
7.3 - Engineered Safety Features Systems,  
7.4 - Safe Shutdown Systems,  
7.5 - Information Systems Important to Safety,  
7.6 - Interlock Systems Important to Safety,  
7.7 - Control Systems,  
7.8 - Diverse Instrumentation and Control  
Systems,  
7.9 - Data Communication Systems
- BTP 7-8**  
Guidance for Application of  
Regulatory Guide 1.22
- BTP 7-19 \***  
Guidance for Evaluation of Diversity and  
Defense-in-Depth in Digital Computer-  
Based I&C Systems
- ISG-06 \***  
Licensing Process  
(D.1 – System Description,  
D.2 – System Architecture,  
D.6 – IEEE Std 603/IEEE Std 7-4.3.2  
Compliance/Conformance)

\*Digital-Specific

# Criteria for Safety System Programmable Digital Devices

## Criteria for Safety System Programmable Digital Devices

### Regulatory Requirements & Policy

- 10 CFR Part 50**  
CP, OL
- 10 CFR Part 52**  
DC, COL, SDA, ML
- 10 CFR Part 50, Appendix A**  
General Design Criteria  
21
- 10 CFR Part 50, Appendix B**  
Quality Assurance  
Criteria
- 50.55a(h)**  
IEEE Std 603-1991  
IEEE Std 279-1971
- SRM-SECY-22-0076,**  
**SRM-SECY-93-087 \***  
Item 18

### Regulatory Guidance

**RG 1.152, Rev. 4**  
Criteria for Programmable Digital  
Devices in Safety-Related Systems  
of NPPs

**IEEE Std 7-4.3.2-2016**  
Standard Criteria for PDDs in  
Safety Systems of Nuclear Power  
Generating Stations

Applicable IEEE Std 7-4.3.2-2016 Clauses	
5.1	Single-Failure Criterion
5.5	System Integrity
5.5.1	Design for PDD Integrity
5.5.2	Design for Test and Calibration
5.5.3	Fault Detection and Self-Diagnostics
5.5.4	Prioritization of Functions
5.6	Independence
5.7	Capability for Testing and Calibration
5.8	Information Displays
5.9	Control of Access
5.11	Identification
5.15	Reliability
5.16	Common Cause Failure Criteria
5.18	Simplicity

### Staff Guidance

- NUREG-0800**  
Standard Review Plan, Chapter 7
- BTP 7-17 \***  
Guidance on Self-Test and Surveillance  
Test Provisions
- BTP 7-19 \***  
Guidance for Evaluation of Diversity  
and Defense-in-Depth in Digital  
Computer-Based I&C Systems
- BTP 7-21 \***  
Guidance on Digital Computer  
Real-Time Performance
- ISG-04 \***  
Highly-Integrated  
Control Room Communications
- ISG-06 \***  
Licensing Process  
(D.1 – System Description,  
D.2 – System Architecture,  
D.5 – Applying a Topical Report,  
D.6 – IEEE Std 603/IEEE Std 7-4.3.2  
Compliance/Conformance,  
D.8 – SDOE)

\*Digital-Specific

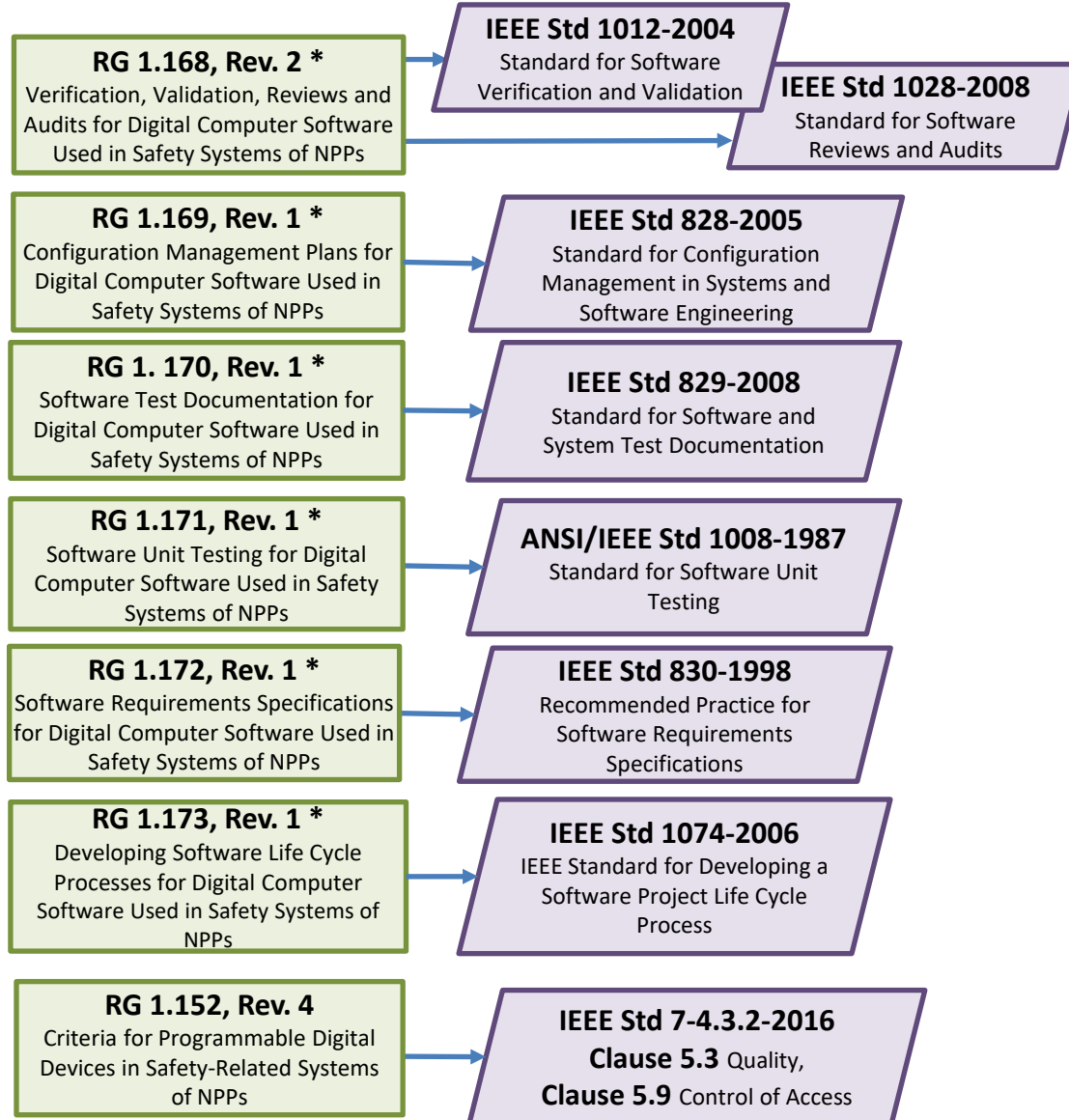
# Digital Development and Reliability

## Digital Development and Reliability

### Regulatory Requirements

- 10 CFR Part 50  
CP, OL
- 10 CFR Part 52  
DC, COL, SDA, ML
- 10 CFR Part 50,  
Appendix A  
General Design Criteria  
1, 21
- 10 CFR Part 50,  
Appendix B  
Quality Assurance  
Criteria
- 50.55a(h)  
IEEE Std 603-1991  
IEEE Std 279-1971

### Regulatory Guidance



### Staff Guidance

- NUREG-0800**  
Standard Review Plan,  
Chapter 7
- BTP 7-14 \***  
Guidance on Software Reviews for Digital Computer-Based I&C Systems
- ISG-06 \***  
Licensing Process  
(D.4 – Digital I&C System Development Processes,  
D.8 – SDOE,  
D.9 – Other Review Guidance for Tier 1, 2, and 3 Reviews)

\*Digital-Specific



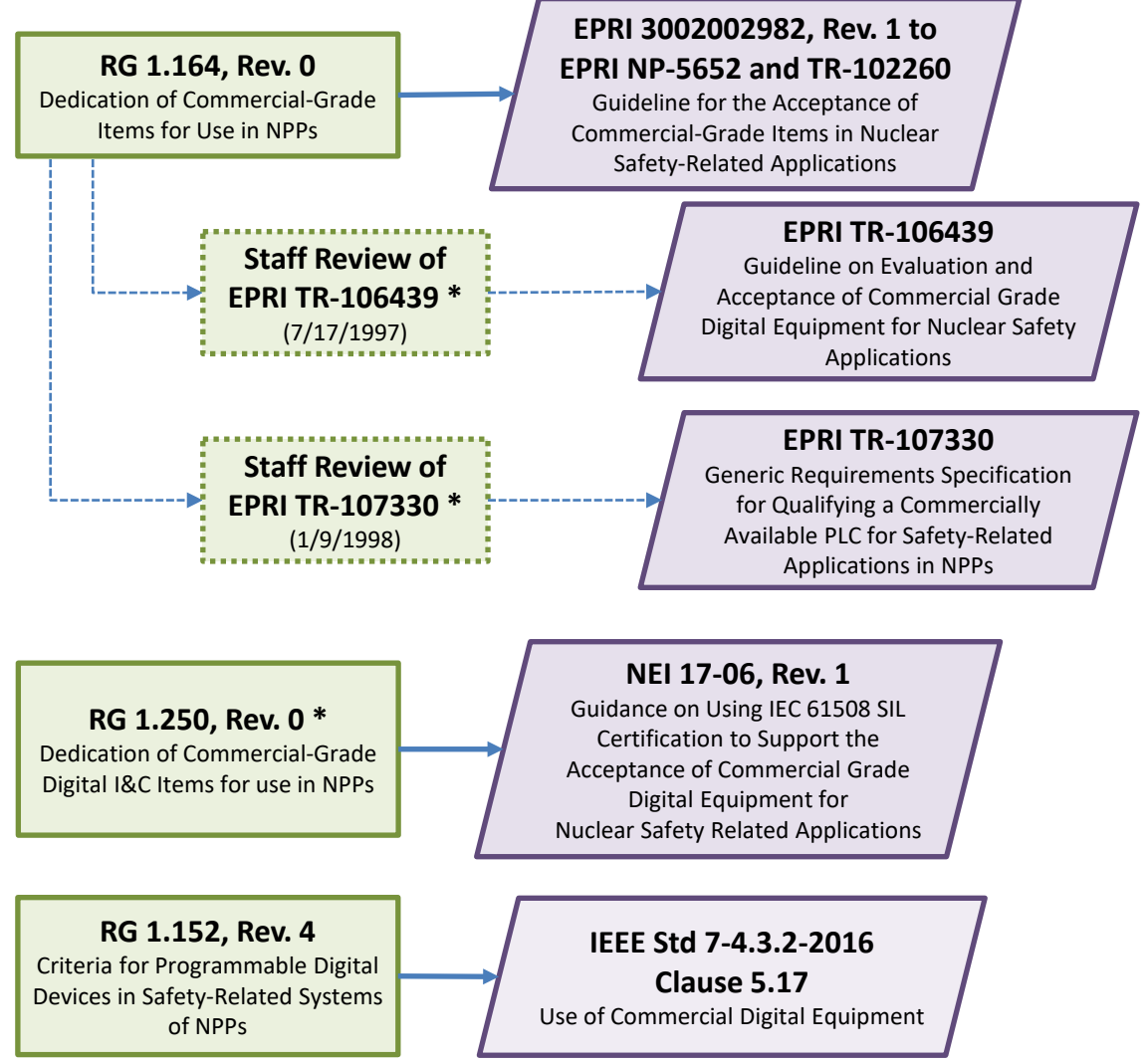


# Commercial Grade Dedication

## Regulatory Requirements

- 10 CFR Part 21**  
Reporting of Defects and Noncompliance
- 10 CFR Part 50**  
CP, OL
- 10 CFR Part 52**  
DC, COL, SDA, ML
- 10 CFR Part 50, Appendix A**  
General Design Criteria 21
- 10 CFR Part 50, Appendix B**  
Quality Assurance Criteria
- 50.55a(h)**  
IEEE Std 603-1991  
IEEE Std 279-1971

## Regulatory Guidance



## Staff Guidance

- NUREG-0800**  
Standard Review Plan, Chapter 7
- BTP 7-14 \***  
Guidance for Software Review for Digital Computer-Based Instrumentation and Control Systems
- ISG-06 \***  
Licensing Process (D.9.9 – Commercial-Grade Dedication of Digital Equipment)

Commercial Grade Dedication

\*Digital-Specific

# Equipment Qualification

## Equipment Qualification

### Regulatory Requirements

**10 CFR Part 50**  
CP, OL

**10 CFR Part 52**  
DC, COL, SDA, ML

**10 CFR Part 50, Appendix A**  
General Design Criteria  
1,2,4,13,21,23

**50.49**  
Environmental Qualification of Electric Equipment Important to Safety for NPPs

**50.55a(h)**  
IEEE Std 603-1991  
IEEE Std 279-1971

### Regulatory Guidance

**RG 1.89, Rev. 2**  
Environmental Qualification of Certain Electric Equipment Important for Safety for NPPs

**RG 1.209, Rev. 0 \***  
Guidelines for EQ of Safety-Related Computer-Based I&C Systems in NPPs

**RG 1.100, Rev. 4**  
Seismic Qualification of Electric and Mechanical Equipment for NPPs

**RG 1.180, Rev. 2**  
Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related I&C Systems

**RG 1.152, Rev. 4**  
Criteria for Programmable Digital Devices in Safety-Related Systems of NPPs

**IEC/IEEE Std 60780/323-2016**  
Electrical Equipment Important to Safety—Qualification

**IEEE Std 323-2003**  
Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations

**IEEE Std 344-2013**  
Standard for Seismic Qualification of Equipment

**IEEE Std C37.98-2013**  
Seismic Qual. Testing of Protective Relays and Auxiliaries

**ASME QME-1-2017**  
Qualification of Active Mechanical Equipment

**IEEE Std 1050-2004**      **MIL-STD-461G**

**IEEE Std C62.45-2002**      **IEC 61000-3**

**IEEE Std C62.41.1-2002**      **IEC 61000-4**

**IEEE Std C62.41.2-2002**      **IEC 61000-6**

**IEEE Std 7-4.3.2-2016, Clause 5.4**  
Equipment Qualification

### Staff Guidance

**NUREG-0800**  
Standard Review Plan, Chapter 7

**ISG-06 \***  
Licensing Process (D.3 – Hardware Equipment Qualification)

\*Digital-Specific

# Accident Monitoring Instrumentation

## Accident Monitoring Instrumentation

### Regulatory Requirements & Orders

- 10 CFR Part 50  
CP, OL
- 10 CFR Part 52  
DC, COL, SDA, ML
- 10 CFR Part 50, Appendix A  
General Design Criteria 19
- 10 CFR 50.34(f)(2)(xix)  
Additional TMI-related Requirements
- 10 CFR 50.155(e)  
Spent Fuel Pool Monitoring

### Regulatory Guidance

**RG 1.97, Rev. 5**  
Criteria for Accident Monitoring Instrumentation for NPPs



**IEEE Std 497-2016**  
Standard Criteria for Accident Monitoring Instrumentation for Nuclear Power Generating Stations

### Staff Guidance

- NUREG-0800**  
Standard Review Plan, Chapter 7
- BTP 7-10**  
Guidance on Application of Regulatory Guide 1.97

# Setpoint Establishment and Maintenance

## Regulatory Guidance

### Regulatory Requirements

**10 CFR Part 50**  
CP, OL

**10 CFR Part 52**  
DC, COL, SDA, ML

**10 CFR Part 50, Appendix A**  
General Design Criteria  
13, 20

**10 CFR 50.36(c)(1)(ii)(A)**  
Technical Specifications

**50.55a(h)**  
IEEE Std 603-1991  
IEEE Std 279-1971

**RG 1. 105, Rev. 4**  
Setpoints for Safety-Related  
Instrumentation

**ANSI/ISA 67.04.01-2018**  
Setpoints for Nuclear Safety-  
Related Instrumentation

### Staff Guidance

**NUREG-0800**  
Standard Review Plan,  
Chapter 7

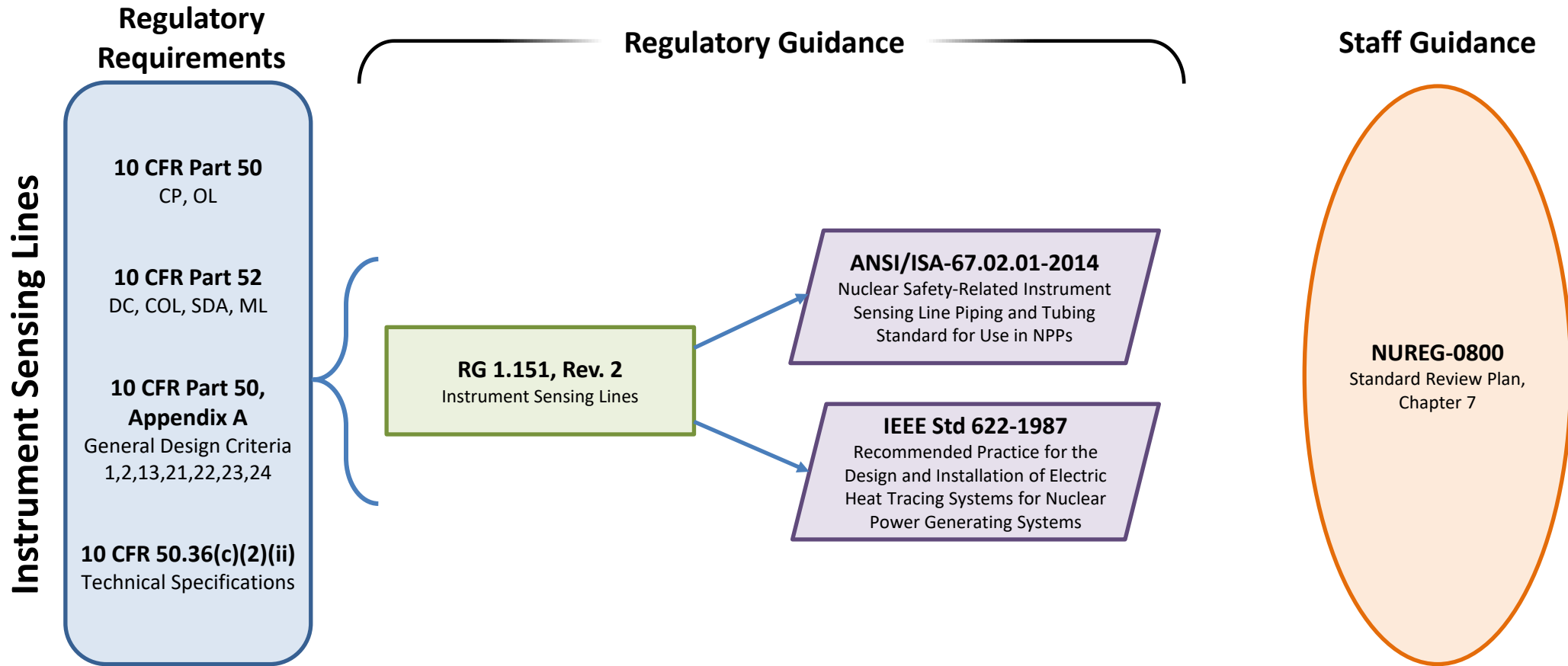
**BTP 7-12**  
Guidance on Establishing  
and Maintaining  
Instrument Setpoints

**ISG-06 \***  
Licensing Process  
(D.7 – Technical  
Specifications)

Setpoints Establishment  
and Maintenance

\*Digital-Specific

# Instrument Sensing Lines



# Cyber Security

## Regulatory Requirements

**10 CFR Part 50**  
OL

**10 CFR Part 52**  
COL

**10 CFR 73.1**  
Purpose and Scope

**10 CFR 73.54**  
Protection of Digital  
Computer and  
Communication  
Systems and Networks

**10 CFR 73.77**  
Cyber Security Event  
Notifications

## Regulatory Guidance

**RG 5.71, Rev. 1**  
Cyber Security Programs for  
Nuclear Facilities

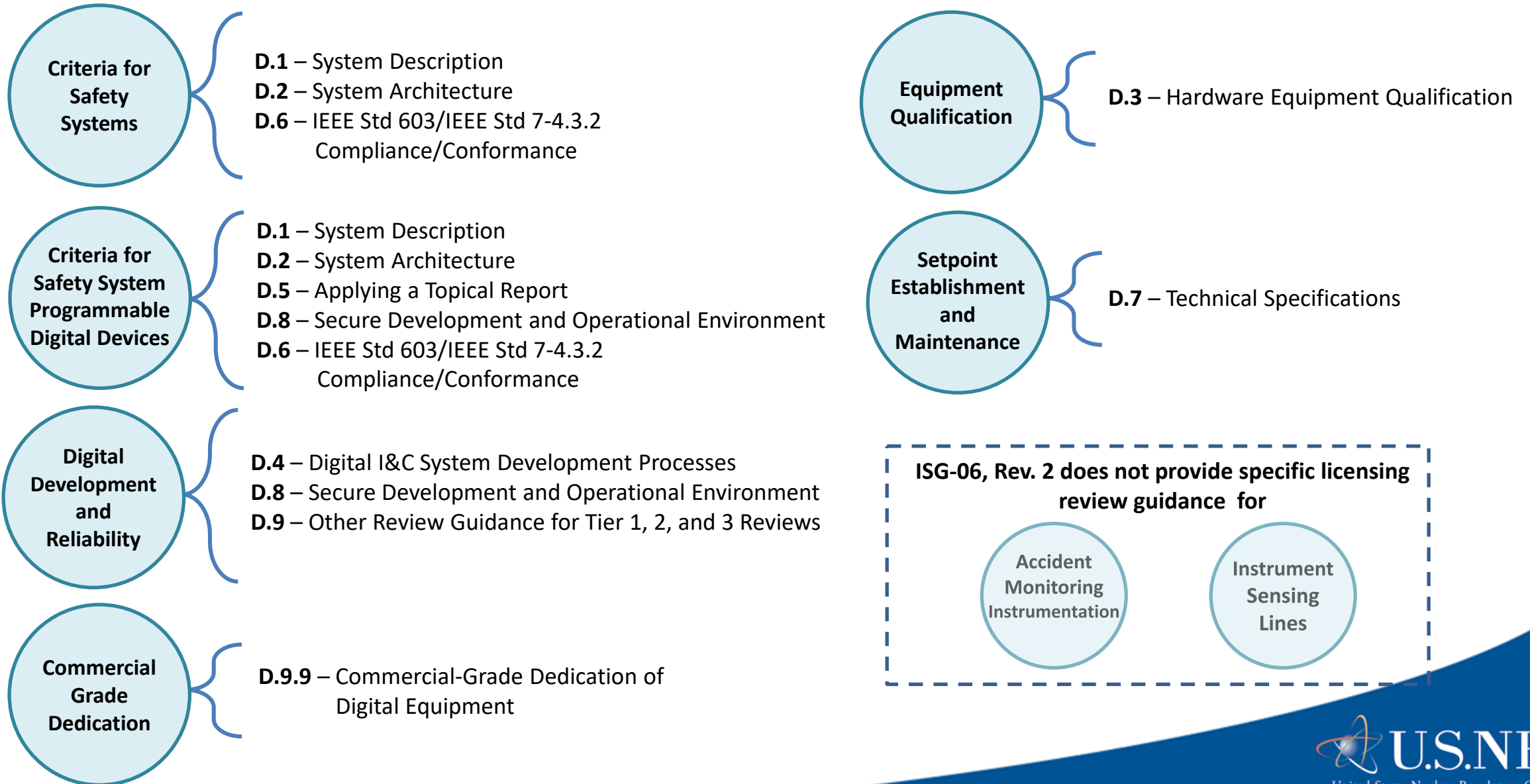
**RG 5.83, Rev. 0**  
Cyber Security Event Notifications

## Staff Guidance

**NUREG-0800**  
Standard Review Plan,  
Section 13.6.6

Cyber Security

# I&C Technical Areas & ISG-06, “Licensing Process”



# References

- Commission Papers (SECY) - <https://www.nrc.gov/reading-rm/doc-collections/commission/secys/index.html>
- Staff Requirements Memoranda - <https://www.nrc.gov/reading-rm/doc-collections/commission/srm/index.html>
- Regulatory Guides - <https://www.nrc.gov/reading-rm/doc-collections/reg-guides/power-reactors/rg/index.html>
- Interim Staff Guidance - <https://www.nrc.gov/reading-rm/doc-collections/isg/index.html>
- Review of EPRI TR-106439, Guideline on Evaluation and Acceptance of Commercial Grade Digital Equipment for Nuclear Safety - <https://www.nrc.gov/docs/ML0921/ML092190664.pdf>
- Safety Evaluation of EPRI TR-107330, Generic Requirements Specification for Qualifying a Commercially Available PLC for Safety-Related Applications in NPPs - <https://www.nrc.gov/docs/ML1220/ML12205A265.pdf>
- IEEE Standards - <https://ieeexplore.ieee.org/Xplore/home.jsp>



# Acronyms

Acronym	Description	Acronym	Description
ANSI	American National Standards Institute	ISG	Interim Staff Guidance
ASME	American Society of Mechanical Engineers	LWR	Light-Water Reactor
BTP	Branch Technical Position	ML	Manufacturing License
CFR	Code of Federal Regulations	NEI	Nuclear Energy Institute
COL	Combined Operating License	NPP	Nuclear Power Plant
CP	Construction Permit	NPUFs	Non-power Production and Utilization Facilities
DC	Design Certification	NRC	Nuclear Regulatory Commission
DI&C	Digital Instrumentation and Controls	OL	Operating License
DG	Draft Guide	QA	Quality Assurance
DRG	Design Review Guide	PDD	Programmable Digital Device
DSRS	Design Specific Review Standard	PLC	Programmable Logic Controller
EPRI	Electric Power Research Institute	RG	Regulatory Guide
I&C	Instrumentation and Controls	SDA	Standard Design Approval
IEC	International Electrotechnical Commission	SRM	Staff Requirements Memorandum
IEEE	Institute of Electrical and Electronics Engineers	SRP	Standard Review Plan
ISA	International Society of Automation	V&V	Verification and Validation