

Overview of Nuclear Regulatory Inspection Program

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Yusuke KASAGAWA Nuclear Regulation Authority (NRA) Japan ©2025 Nuclear Regulation Authority (NRA)



About NRA

Established in September 2012





As of 6 September 2024

NRA Regional Offices









NRA's oversight programme since 2020

The IAEA IRRS mission to NRA in 2016 provided Recommendations and Suggestions for the inspection program to be developed and improved

Key concepts

- Risk-informed and Performance-Based
- Graded Approach
- Free Access to licensee facilities and information

Implementation of USNRC's Reactor Oversight Process (ROP) that is designed to be risk-informed and performance based.



- (1) Regulatory inspections should be improved so that they do not substitute for the control, supervision, and verification activities conducted by the authorized party itself. → Responsibility for safety and Role of government
- (2) The scope of regulatory inspections should cover all safety activities of licensees. → Free access
- (3) The inspection approach should be more effective by applying riskinformed and performance-based inspections.
- (4) The inspection framework should be simplified, flexible, and effective by streamlining the scope of various regulatory inspections and monitoring. → Allow NRA decisions about reactive inspections to be made at the lowest possible level. Graded approach



Statements related to Inspection

• Key Concepts - (1) Responsibility for safety and Role of Government

Safety Fundamentals (SF)

Principle 1: Responsibility for safety

The prime responsibility for safety must rest with the person or organization responsible for facilities and activities that give rise to radiation risks.

Principle 2: Role of government

An effective legal and governmental framework for safety, including an independent regulatory body, must be established and sustained.

General Safety Requirements (GSRs)

Part 1 Requirement 29, paragraph 4.49

Regulatory inspection cannot diminish the prime responsibility for safety of the authorized party, and cannot substitute for the control, supervision and verification activities conducted under the responsibility of the authorized party.



Statements related to Inspection

• Key Concepts - (2) Free access, (3) more effective Inspections

General Safety Requirements (GSRs)

Part 1 Requirement 29, para. 4.52

Regulatory inspections shall cover all areas of responsibility of the regulatory body, and the regulatory body shall have the authority to carry out independent inspections. Provision shall be made for free access by regulatory inspectors to any facility or activity at any time, within the constraints of ensuring operational safety at all times and other constraints associated with the potential for harmful consequences. These inspections may include, within reason, unannounced inspections. The manner, extent, and frequency of inspections shall be in accordance with a graded approach.



Statements related to Inspection

• Key Concepts - (4) Inspection framework

General Safety Requirements (GSRs)

Part 1 Requirement 2 paragraph 2.5 the government shall promulgate laws and statutes to make provision for an effective governmental, legal, and regulatory framework for safety. This framework for safety shall set out the following: ... (10) Provision for the inspection of facilities and activities, and for the enforcement of regulations, in accordance with a graded approach;

Part 1 Requirement 29, paragraph 4.52. The manner, extent, and frequency of inspections shall be in accordance with a graded approach.

Part 1 Requirement 30 The regulatory body shall establish and implement an enforcement policy within the legal framework for responding to noncompliance by authorized parties with regulatory requirements or with any conditions specified in the authorization.



• **Risk** – Risk has many definitions, for example:

Risk = Probability x Consequences

- Risk can also be expressed by the following three questions (*Risk Triplet*):
 - What can go wrong ?

(accident scenario)

– How likely is it?

(frequency on a per reactor year basis)

– What are the consequences?

(impact on plant or on people)



Probabilistic Risk Assessment (PRA) - PRA is a structured, analytical process for identifying potential weaknesses and strengths of a plant design in an integrated fashion. PRA provides a framework for explicitly addressing and presenting uncertainties (vs. making conservative assumptions to deal with uncertainty and risk)



An approach in which risk insights, engineering analysis and judgment (including the principle of Defense-in-depth and safety margins), and performance history are used, to (purposes)

- (1) focus attention on the most important activities,
- (2) establish objective criteria for evaluating performance,
- (3) develop measurable or calculable parameters for monitoring system and licensee performance,
- (4) provide flexibility to determine how to meet the established performance criteria in a way that will encourage and reward improved outcomes, and
- (5) focus on the results as the primary basis for regulatory decisionmaking.

Risk-Informed Concept







- The regulatory inspection program measures plant performance in three key areas:
 - Nuclear Facility Safety avoiding accidents and reducing the consequences if they do occur
 - Radiation Safety for both plant workers and the public from unnecessary exposures
 - Physical Protection protection of the plant against sabotage or other security threats.
- The three broad key areas are each divided into "Cornerstones" which provide "inspectable" areas.
- To measure plant performance, the regulatory inspection program focuses on seven **Cornerstones** that support the safety of plant operations in the three key areas.



The NRA's fundamental mission is to protect the general public and the environment through rigorous and reliable regulations of nuclear activities



Cross-Cutting Areas

Safety culture fostering activities (including activities related to the interface with nuclear security culture)

Ability of personnel work practices

Problem Identification and Resolution

Scheme of Nuclear Oversight Program



• Nuclear plant performance is measured and assessed by a combination of inspection findings and PIs.



Significance Evaluations



• Classification according to the inspection findings and the performance indicators (Nuclear Power Plants)

Green	Very low and limited impact on Safety function and performance. Green significance indicates that the licensee performance is acceptable. It can be improved through licensee's corrective action. (Including no performance deficiency for performance indicators)
White	Low impact on Safety function and performance. Cornerstone objectives are met with minimal reduction in safety margin. NRA should monitor the corrective action of licensee.
Yellow	Substantial impact on Safety function and performance. Yellow significance indicates a decline in licensee performance that is still acceptable with cornerstone objectives met, but with significant reduction in safety margin.
Red	High impact on Safety function and performance.



- **1. Baseline inspections** represent the <u>minimum</u> level of inspection required to ensure plant safety and security and are common to all intended nuclear plants and facilities.
- 2. Supplemental inspections are inspections of performance issues <u>beyond</u> the baseline program. These additional inspections are based on criteria specified in the assessment program to address declining licensee performance and is not included in the baseline program.
- 3. Special inspections are performed mainly in response to a significant operational event.
- NRA usually conducts Daily Inspections and Team Inspections
 - Daily Inspections are mainly conducted by the resident inspectors.
 - Team Inspections are mainly conducted by the headquarters inspectors with specialized knowledge at a certain frequency.

Specified areas

- Design control (electrical, mechanical, I&C, SSC),
- > In-Service Inspection, NDE,
- QMS, Problem Identification & Resolution, Safety Culture,
- ➢ Fire protection,
- ➢ Radiation protection,
- > Emergency preparedness, Severe Accident countermeasures (drill, equipment), etc. 16



Two simple questions for Issue of Concern to identify Inspection Finding

- Is there a Performance Deficiency?
- Is the PD More-than-Minor?





Issue of Concern

 A well-defined observation or collection of observations that may have a bearing on safety or security which may warrant further inspection, screening, evaluation, or regulatory action.

Performance Deficiency ?

• The licensee's failure to satisfy one or more regulatory requirements or self-imposed standards where such failure was reasonably foreseeable and preventable.

More-than-Minor ?

If the answer to any of the following questions is "yes," then the PD is MTM and is a **finding**. If the answer to all of the following questions is "no," then the PD is minor and is not a finding.

- Adversely affecting the associated cornerstone objective?
- Precursor to a significant event?
- If left uncorrected, Potential to lead to a more significant safety concern?



• SDP is a risk-informed process used to help NRA inspectors and staff determine the safety significance of inspection findings.

Quantitative Significance Evaluation (For NPP Inspection Findings At-Power)



CDF: Core Damage Frequency CFF: Containment Failure Frequency





- Risk Significance:
 - Classified as ΔCDF averaged over 1 year

Qualitative Significance Evaluation



If no quantitative tools (e.g., PRA) exist to evaluate the finding, an integrated risk-informed decision-making approach using qualitative criteria should be used to evaluate its significance.

• Basic concept

Factors directly related to risk significance (Defense-in-depth, Safety margin, Importance of safety function, etc.)

(Duration) Other factors affecting risk significance (Recovery actions, Iteration, Operation experience, etc.)



Discussion items

- What are the decision attributes
- How to evaluate each attribute
- How to integrate the results into the significance

Performance Indicators



- A "performance indicator" is a quantitative measure of a particular attribute of licensee performance that indicates how well a plant is performing when measured against established *thresholds*.
 - For some PIs, White/Yellow or Yellow/Red thresholds were not identified, because the indicators could not be directly tied to risk data.
- Performance indicators are "snap-shots" of licensee performance in certain areas over a one-quarter year period.
- Performance indicators are reported by the licensees on a quarterly basis, reviewed by the NRA staff, and posted on the NRA's Web site.

Performance Indicators (cont.)







Cornerstones and Associated Performance Indicators (1/2)

Cornerstone	PI	G	W	Y	R
#1	(1) No. of Unplanned Automatic or Manual Scrams per 7,000 Critical-hrs	0 ~ 2.0	>2.0	>6.0	>25.0
Abnormality Prevention	(2) No. of Unplanned Power Changes per7,000 Critical-hrs	0~2.0	>2.0	N/A	N/A
	(3) No. of Unplanned Scrams with Additional Operator Actions	<1	≧1	N/A	N/A
#2	(4) Unavailability of Safety Systems	0 ~ 3.4%	>3.4%	>6.8%	N/A
Mitigation Functions	(5) No. of Occurrences of Functional Failures of Safety Systems (Occurrences to Deviation from LCO)	≦3	≧4	N/A	N/A
#3	(6) Leak Rate from RCS inside CV (Ratio to Exceed Allowed Threshold)	0 ~ 50.0 %	>50.0 %	>100.0 %	N/A
Barrier Integrity	(7) Activity Level of I-131 in RCS (Ratio to Exceed Allowed Threshold)	0 ~ 50.0 %	>50.0 %	>100.0 %	N/A



Cornerstones and Associated Performance Indicators (2/2)

Cornerstone	PI	G	W	Y	R
	(8) Severe Accident Drill/Exercise Participation	≧80.0%	<80.0%	<60.0%	N/A
#4 Severe Accident	(9) Severe Accident Drill/Exercise Performance	100~ 90.0%	<90.0%	<70.0%	N/A
Measures	(10) No. of Occurrences of FunctionalFailures of Severe AccidentCountermeasure Equipment (Occurrencesto Deviation from LCO)	≦3	≧4	N/A	N/A
#5 Public Radiation Safety	(12) No. of Occurrences of Excessive Release of Radioactive Waste Materials	<1	1	≧2	N/A
#6 Occupational	(13) No. of Occurrences to Exceed Allowed Threshold of Maximum Individual Dose	<1	1	≧2	-
Radiation Safety	(14) No. of Events of Unplanned Excessive Dose Exposure	<1	1	≧2	-
#7 Physical Protection	(15) Unavailability of Protected AreaEquipment (Note: Not publicly available)	0~0.080	>0.080	N/A	N/A





• Adequate Performance = Normal Regulatory Attention

(e.g., baseline inspections)

• Declining Performance = Increasing Regulatory Attention

(e.g., supplemental inspections)



Action Matrix Concept



- Increasing safety significance
- Increasing NRA inspection efforts

Supplemental inspections are performed when white, yellow, or red inspection findings are identified or when performance indicators exceed response thresholds.

Enforcement Process



Severity Evaluation of Violation



In associated with

- 1. Impeding the regulatory process
- 2. Actual consequences on nuclear safety
- 3. Willfulness



Relationship between Safety Significance and Severity Level



Safety Significance

(Performance Deficiency) 28

Results of nuclear regulatory inspection



Low

1

1 2 1

NFFs, etc.

High

Inspection					Safet	Security							
Findings -	Fiscal Ye		NP	Ps		NFFs	<i>,</i> etc.	NPPs					
Significance			G	w	Υ	R	Low	High	G	w	Y	R	
Evaluations	2020	1 st Q 2 nd Q 3 rd Q 4 th O	2 5 3 7						1 1 5	1		1	
	2021	1 st Q 2 nd Q 3 rd Q 4 th Q	4 5 11 5				2 2		1 1 2			-	
	2022	1 st Q 2 nd Q 3 rd Q 4 th Q	3 6 2 5				1 1 1		1 3 1 3				
	2023	1 st Q 2 nd Q 3 rd Q 4 th Q	7 4 2 13				1		1 1 1				
	2024	1 st O	1						1				

* Excluding the violations evaluated only with the severity level

2ndQ

3rdQ

1

3

(As of end-

Dec.)

3



Security Significant Issues at Kashiwazaki-Kariwa

- 1. Unauthorized Access to the Controlled Area: White/SL III, 2020Q3
- A licensee(TEPCO)'s staff accessed the control room by using another staff's ID card in Sep. 2020
- Security guards did not have adequate personality check and the TEPCO's staff identification data was re-registered on the different staff's ID card.
- 2. Partial Loss of Physical Protection Function: Red/SL I, 2020Q4
- Several physical protection equipment had been defective, without sufficient complementary measures since Mar. 2020.
 - NRA conducted Supplemental inspections
 - Phase 1 (Apr. 2021 Sep. 2021): Fact-check
 - Phase 2 (Oct. 2021 Apr. 2023): Confirmation of TEPCO's improvement status
 - Phase 3 (May 2023 Dec. 2023): Continue to review unresolved issues



Example: ΔCDF Calculation of an inspection finding

- In 2021, inspectors identified that electric control panels (ECPs) of 3-train Auxiliary Feed-Water systems were located side-by-side without fire barriers.
 - Regulatory requirements: Train separation and fire barriers are required to equipment and <u>cables</u> important to safety for plant shutdown \rightarrow "Cables" in this sentence include ECPs
- Once a fire event occurs in an ECP, other 2 ECPs might lose the function, which means all the AFWs lose their function.
- Assuming the manual trip with function loss of 3 AFWs in the case of a fire event, conditional ΔCDF is 1.6E-3.
- As a detailed risk evaluation, fire propagation analysis showed a fire on an ECP would not affect the other ECPs even without fire barriers.
- NRA concluded this issue would not increase the CDF and it was Green.

Details; 000398642.pdf (nra.go.jp) (Japanese only)



Results of Performance Indicators



• Webpage Examples

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https://www2.nra.go.jp/activity/regulation/kiseikensa/joukyou/pi.html

(in Japanese)



Takahama NPP Unit 3

PI(10): Severe Accident Countermeasure Equipment Functional Failures

	FY2	021		FY2	FY2023			
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
No. of SACE Functional Failures in quarter (Deviations from LCO)	0	0	1	<u>2</u>	0	0	<u>2</u>	0
Total in previous four quarters (Deviations from LCO)	0	0	1	3	3	3	<u>4</u>	2
Indicator Value	0	0	1	3	3	3	<u>4</u>	2
Color	G	G	G	G	G	G	W	G

Thresholds						
Green	≦3					
White	≧4					
Yellow	N/A					
Red	N/A					

Note: Fiscal Year in Japan starts on April 1st and ends on March 31st in the next year.







A Day in the Life of an NRA Resident Inspector

Provide easy-to-understand explanations to those interested in the work of resident inspectors.

Activities of NRA Resident Inspectors





Resident inspectors meeting every morning at the Reginal Office to confirm what inspection activities are scheduled for the day.

To attend the licensee's "Plan of the Day" meeting, each morning.



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Activities of NRA Resident Inspectors (cont.)





To visit the Main Control Room and get information on the plant status.

To walk through the plant and inspect plant facilities and operations. Also observe plant workers.

Activities of NRA Resident Inspectors (cont.)





To ask the licensee a question if it looks wrong.

To meet with the licensee to discuss plant safety issues found during the inspections.



Inspectors are at the front line of eyes and ear of the NRA







Inspectors education/training programme

Improvement of inspectors' competence



Those who aim at the inspector acquire basic knowledge in the (1) Classroom, then improve their skills with various documents in (2) Self Learning, and complete knowledge and skills as an inspector by (3) On the Job Training in the field.

(1) Classroom



(2) Self Learning



(3) OJT

- QMS
- Facility Management
- Operation management
- Radiation control
- Nuclear fuel management etc.

Inspector's ability Competence



- Retraining menu for Inspectors In order to extend the qualifications of inspectors, it is necessary to receive the following retraining.
 - Simulator training
 - Communication education

 (Senior inspectors receive team building education.)
 - Regulatory updates

 (regulation changes, institutional issues, latest operational experience, etc.)
 - On-site Walk-down training

All inspectors need to carry out this re-education within three years.





For Oversight Programme Success

Continuous improvement



Approaches to Success...

- In order to develop and improve the nuclear oversight programme (i.e., Regulatory Inspections and PIs), it is essential to have intensive and frequent engagement with nuclear industry.
- NRA basically once a quarter holds an information exchange meeting with nuclear industry on the nuclear oversight program and results.
- NRA's activities are recognized by nuclear industry through an open and transparent dialogue with them and the NRA encourages licensees' efforts on safety improvement.



Photo image of a meeting between NRA and licensees

(Reference) List of Regulations and Guides





Thank you for your attention

https://www.nra.go.jp/english/

Questions and Answers