

Submitted to the "ASME Nuclear Energy Division Newsletter" for publication in late August 2000. This pre-print (draft) is not to be cited or reproduced.

New NRC Reactor Inspection and Oversight Program

by

David E. Corporandy

The Nuclear Regulatory Commission and its stakeholders, nuclear power plant utilities and concerned public interest groups, recognized the importance of improving the efficiency, effectiveness, and consistency of NRCs regulatory program. The new program takes into account improvements in the nuclear power industry over the past twenty years and the desire of the NRC to apply more objective, timely, and safety-significant criteria in assessing performance, as well as the agency's need to effectively regulate the industry with a smaller staff and budget.

The evidence on nuclear power plant performance since the mid 1980's suggests significant improvement in nuclear power plant safety and reliability. The number of automatic shutdowns, the number of significant safety problems, and the number of outages caused by equipment problems have all decreased.

The improvements in plant performance can be attributed both to efforts within the nuclear industry and to successful regulatory oversight. Despite this success, the NRC was concerned that the prior processes for inspection, assessment, and enforcement

were not always focused on the most important safety issues. In some situations regulatory activities had been redundant or inefficient and, at times, overly subjective. NRC actions had not always been sufficiently understandable or predictable.

The new program addresses these concerns by focusing on four key issues: maintaining safety, enhancing public confidence, improving effectiveness and efficiency, and reducing unnecessary regulatory burden by implementing an oversight program that calls for:

- Focusing inspections on activities where the potential risks are greater
- Applying greater regulatory attention to facilities with performance problems while giving proper regulatory attention to facilities that perform well
- Using objective measurements of the performance of nuclear power plants whenever possible
- Giving the nuclear industry and the public timely and understandable assessments of plant performance

- Minimizing unnecessary regulatory burdens of nuclear facilities

- Responding to violations of regulations in a predictable and consistent manner that reflects the safety impact of the violations

Elements of the New Program

The objective of the new program is to monitor performance in three key areas: reactor safety (avoiding accidents and reducing the consequences of accidents if they occur); radiation safety (for plant workers and the general public); and protection of the plant against sabotage or other security threats.

The new inspection program identifies the important elements of each of these key areas and refers to them as cornerstones. The table below lists these cornerstones of safe nuclear plant operation, as well as those elements which cut across each of the cornerstones.

Reactor Safety Cornerstones
<ul style="list-style-type: none"> • Initiating Events - minimizing events that could lead to an accident • Mitigation Systems - assure the ability of safety systems to respond to and lessen the severity of an accident • Barrier Integrity - maintain barriers to the release of radioactivity in an accident • Emergency Preparedness - plans by the utility and governmental agencies to shelter or evacuate people in the community in the event of a severe accident
Radiation Safety Cornerstones
<ul style="list-style-type: none"> • Plant worker - minimize exposure during routine operations • General public - provide adequate protection during routine operations
Security Cornerstone
<ul style="list-style-type: none"> • Physical protection of plant and nuclear fuel
Cross-Cutting Elements
<p>Three cross-cutting elements are part of each of these cornerstones:</p> <ul style="list-style-type: none"> • Human performance • Management attention to safety and workers' ability to raise safety issues ("Safety-conscious" work environment) • Finding and fixing problems (Utility's corrective action program)

The new program normally measures plant performance in two basic ways: Performance indicators, which use objective data to monitor performance; and

NRC baseline inspections, which monitor performance not covered by the performance indicators. Nuclear utilities have volunteered to provide the

performance indicator data to the NRC on a quarterly basis. The table below shows the current performance indicators for each of the cornerstones.

Safety Cornerstone	Performance Indicator
Initiating Events	Unplanned Reactor Shutdowns (automatic and manual) per 7000 Critical Hours
	Unplanned Reactor Shutdowns with a Loss of Normal Heat Removal
	Unplanned Power Changes per 7000 Critical Hours
Mitigating Systems	Safety System Unavailability <ul style="list-style-type: none"> • Specific Emergency Core Cooling Systems • Emergency Electric Power Systems
	Safety System Functional Failures

Safety Cornerstone	Performance Indicator
Integrity of Barriers to Release of Radioactivity	Reactor Coolant System Specific Activity (fuel integrity measurement)
	Reactor Coolant System Identified Leak Rate (reactor coolant system integrity measurement)
Emergency Preparedness	Drill/Exercise Performance
	Emergency Response Organization Drill Participation Rate
	Alert and Notification System Reliability (measurement of reliability of notification system for area residents)
Occupational Radiation Safety	Occupational Exposure Control Effectiveness (compliance with regulations for controlling access to radiation areas in plant)
Public Radiation Safety	Radiological Effluent/Offsite Dose Control Manual Effluents Occurrences (releases requiring reporting under NRC regulations and license conditions)
Physical Protection	Protected Area Security Equipment Performance
	Personnel Screening Program Performance
	Employee Fitness-for-Duty/Personnel Reliability Program Performance

Baseline inspections use plant specific probabilistic risk assessment data to rank the safety importance of systems, structures, and components, as well as various activities. That way NRC inspections focus on safety significant issues or higher risk activities. This is referred to as a "risk informed" approach. The baseline inspections concentrate in three areas:

1. Inspection of areas not fully covered by the performance indicators.
2. Inspections to verify the accuracy of information provided by a licensee's performance indicators.
3. A comprehensive review of the utility's effectiveness in finding and resolving problems.

Assessing Plant Performance

The data from performance indicators and the baseline inspections are continually assessed for their safety importance; however, the NRC resident inspectors together with regional managers formally review the performance of each nuclear plant on a quarterly basis. Annually, safety performance is reviewed with the agency's executive management team to gain insights relative to industry wide performance.

Inspection findings undergo a formal process called the Significance Determination Process to categorize their safety significance. Performance Indicators have pre-determined thresholds which define their significance.

The Significance Determination Process utilizes plant specific data from the probabilistic risk assessment to determine the risk associated with events and inspection findings. By using the prescriptive approach of the Significance Determination Process, the NRC's response will be predictable, consistent, and objective.

Every performance indicator and inspection finding are categorized to determine the appropriate regulatory response:

Category "Green" -

Performance calling only for NRC "baseline" oversight

- Cornerstone objectives fully met
- No significant deviation from expected performance

Category “White” -
Performance calling for increased regulatory response

- Cornerstone objectives met with minimal reduction in safety margin
- Outside bounds of expected performance
- Changes in performance but with very small effect on accident risk

Category “Yellow” -
Performance calling for required regulatory response

- Cornerstone objectives met but with reduction in safety margin
- Changes in performance with a small effect on accident risk

Category “Red” - Unacceptable performance

- Plant performance significantly outside design basis
- Loss of confidence in ability of plant to provide assurance of public health and safety if it continues to operate
- Significant reduction in margins of safety.

NRCs Response to Performance

The NRCs quarterly reviews of plant performance, using the performance indicators and inspection findings, determine

if and when additional action, is needed. This process is intended to be more predictable than previous practices by linking regulatory actions to performance criteria. The new process provides for levels of regulatory response beyond the baseline inspection and oversight program. The first two levels of increased regulatory review would be managed by the appropriate regional office: The higher levels would be an agency level response, involving the attention of senior managers from both headquarters and a regional office.

Assessment of Plant Performance (in order of increasing safety significance)	NRC Response
I. All Performance Indicators and Cornerstone Inspection Findings GREEN <ul style="list-style-type: none"> • Cornerstone objectives fully met. 	<ul style="list-style-type: none"> • Routine resident inspector and staff interaction • Normal baseline Inspection program • Annual assessment public meeting
II. One or two different cornerstones with a single WHITE input <ul style="list-style-type: none"> • Cornerstone objectives fully met 	Response at Regional level <ul style="list-style-type: none"> • Staff to hold public meeting with utility management • Utility corrective action to address WHITE inputs with NRC oversight • NRC inspection followup on WHITE inputs and corrective action

<p>III. One degraded cornerstone (two inputs WHITE or one input YELLOW) or three separate Cornerstones with WHITE inputs</p> <ul style="list-style-type: none"> • Cornerstone objectives met with minimal reduction in safety margin 	<p>Response at Regional level</p> <ul style="list-style-type: none"> • Senior Regional Management to hold public meeting with utility management • Utility to conduct self-assessment with NRC oversight • Utility submits response to degraded area • Additional inspections focused on cause of degraded performance
<p>IV. Repetitive degraded cornerstones, multiple degraded cornerstones</p> <ul style="list-style-type: none"> • Cornerstone objectives met with longstanding issues or significant reduction in safety margin 	<p>Response at Agency level</p> <ul style="list-style-type: none"> • Executive Director for Operations to hold public meeting with senior utility management • Utility develops performance improvement plan with NRC oversight • NRC team inspection focused on cause of degraded performance • "Demand for Information" or "Confirmatory Action Letter" or Order
<p>V. Overall RED (unacceptable performance)</p> <ul style="list-style-type: none"> • Unacceptable reduction in safety margin 	<p>Response at Agency level</p> <ul style="list-style-type: none"> • Plant not permitted to operate • Commission meeting with senior utility management • Order to modify, suspend, or revoke license

Closing Comments

The new NRC reactor inspection and oversight program represents a comprehensive change in approach, not only in how performance is measured and evaluated but also in its development. In crafting the new program, NRC solicited the input and involvement of nuclear industry leaders as well as public interest groups such as the Union of Concerned Scientists. In its commitment to effectively oversee the continued safe

operation of commercial nuclear power, the NRC recognizes the need for continuous program evaluation and improvement.

The following are a few thoughts for the future. Continue to refine Performance Indicators to search for those which most accurately reflect performance. Set standards for Individual Plant Probabilistic Risk Assessments to assure that safety significance and risk are consistently applied

industry wide. Continue research on the human performance elements of Probabilistic Risk Assessment. Continue to develop methods for evaluating shutdown risk.

References

The NRC world wide web site at www.nrc.gov is a good source for further information on much of the information discussed in this article. The following table lists some of the information available from NRC's website.

Item	How to Get There	Comments
NUREG - 1649 "New NRC Reactor Inspection and Oversight Program"	Click on "News and Information" Icon, Click on "Reactor Oversight Program in Plain Language"	This provides the most recent revision of NUREG - 1649, the source for most of the information in this article
NRC Inspection Procedures	Click on "News and Information" Icon Click on "Reference Library" Click on "Inspection Manual" Click on "Inspection Procedure"	The inspection procedures describe how NRC inspectors are to implement the inspection program
Plant Performance Indicators	Click on "News and Information" Icon Click on "Nuclear Plant Performance Assessment"	The plant performance indicators for each operating U.S. nuclear plant is provided. Information about the color of each indicator can be obtained by clicking on the indicator of interest.
NRC Inspection Reports	Click on "Public Electronic Reading Room" Follow the directions to install the browser plug-in for NRC's ADAMS (Agency Document Access and Management System) program -or- While viewing a specific Plant Performance Indicator, you can click on the PI button which will allow you to click on a specific inspection results button. This takes you to the most recent Plant Issues Matrix which lists findings. Clicking on the Inspection Report number listed for a finding will take you directly to the inspection report.	Once ADAMS is installed, the user can access the NRC inspection reports for any of the U.S. nuclear power plants.
Current Nuclear News	Click on "News and Information" Icon	Various current information such as news releases, event reports, and preliminary notifications of incidents of interest occurring at NRC regulated facilities are available