Reactor Oversight Process

United States
Nuclear
Regulatory
Commission

July 2000

NRC Reactor Oversight Process

Table of Contents

NRC Reactor Oversight Process

Introduction

The Nuclear Regulatory Commission has revamped its inspection, assessment, and enforcement programs for commercial nuclear power plants. The new oversight process uses more objective, timely, and safety-significant criteria in assessing performance, while seeking to more effectively and efficiently regulate the industry. It also takes into account improvements in the performance of the nuclear industry over the past twenty years.

The NRC tested the new process at thirteen reactors at nine sites across the country on a pilot basis in 1999 to identify what things worked well and what improvements were called for before beginning initial implementation at all nuclear power plants. After a year of experience has been gained with the new oversight process at all plants, the Commission anticipates making further improvements based on this wider experience.

The impetus behind this comprehensive change in approach came both from the NRC's own fundamental reviews of its regulatory program as part of the "reinventing government" process and from concerns expressed by public interest groups, the nuclear industry, and Congress.

The NRC's mission is to ensure adequate protection of public health and safety as it relates to the peaceful uses of nuclear materials in the United States. The agency does not operate nuclear power plants. Rather it regulates the safe operation of the 103 commercial nuclear power plants by mandating requirements for the design, construction and operation of such plants. The NRC conducts a rigorous process for licensing plants to allow them to operate, as well as licensing individual plant operators. The agency provides continuous oversight of plant operations to verify they are being conducted in accordance with regulations.

The NRC also establishes plant-specific technical specifications which must be followed by the plant operators to ensure that the proper combination of safety-related equipment is available to safely shut down the plant in the event of an accident. The NRC has full authority to take whatever action is necessary to protect public health and safety and may demand immediate licensee actions, up to and including a plant shutdown.

The commercial nuclear power industry in the United States is a mature industry. Most of the plants have been operating for more than 10 years, and half of them have operated for more than 20 years. All the evidence suggests that the safety and reliability of the nuclear industry have improved markedly since the late 1980's and early 1990's. The number of automatic shutdowns, the number of significant safety problems, and the number of unplanned outages caused by equipment problems have all decreased. (See Glossary for definitions of terms).

NOTE: For information about the reactor oversight process, go to the NRC's web site at www.nrc.gov/NRR/OVERSIGHT/index.html and also see page 13 of this report.

NRC Reactor Oversight Process

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 has noted that previous processes for inspection, assessment, and enforcement were not always focused on the most important safety issues. In some situations, regulatory activities have been redundant or inefficient and, at times, overly subjective. NRC actions were not always sufficiently understandable or predictable.

To address these concerns, the new oversight program calls for:

- Focusing inspections on activities where the potential risks are greater
- Applying greater regulatory attention to nuclear power plants with performance problems, while maintaining a normal level of regulatory attention on facilities that perform well
- Using objective measurements of the performance of nuclear power plants
- Giving both the public and the nuclear industry timely and understandable assessments of plant performance
- Reducing unnecessary regulatory burden on nuclear facilities
- Responding to violations of regulations in a predictable and consistent manner that reflects the potential safety impact of the violations

The key features of the program deal with new methods for inspecting and assessing performance to ensure safe operation. It spells out more clearly what a nuclear plant operator can expect from the NRC with good plant performance and what can be expected from the NRC, if performance declines.

Setting the Cornerstones of Safe Operation

The new reactor oversight process is, of course, anchored in the NRC's mission to ensure public health and safety in the operation of commercial nuclear power plants. That will always remain the agency's overarching responsibility.

The objective is to monitor performance in three broad areas — **reactor safety** (avoiding accidents and reducing the consequences of accidents if they occur); **radiation safety** for both plant workers and the public during routine operations; and protection of the plant against sabotage or other **security** threats.

To measure plant performance, the oversight process focuses on seven specific "comerstones" which support the safety of plant operations in the three broad performance areas.

Initiating Events - This cornerstone focuses on operations and events at a nuclear plant that could lead to a possible accident, if plant safety systems did not intervene. These events could include equipment failures leading to a plant shutdown, shutdowns with unexpected complications, or large changes in the plant's power output.

Mitigating Systems - This cornerstone measures the function of safety systems designed to prevent an accident or reduce the consequences of a possible accident. The equipment is checked by periodic testing and through actual performance.

NRC Reactor Oversight Process

Barrier Integrity - There are three important barriers between the highly radioactive materials in the fuel within the reactor and the public and the environment outside the plant. These barriers are the sealed rods containing the fuel pellets, the heavy steel reactor vessel and associated piping, and the reinforced concrete containment building surrounding the reactor. The integrity of the fuel rods, the vessel, and the piping is continuously checked for leakage, while the ability of the containment to prevent leakage is measured on a regular basis.

Emergency Preparedness - Each nuclear plant is required to have comprehensive emergency plans to respond to a possible accident. This cornerstone measures the effectiveness of the plant staff in carrying out its emergency plans. Such emergency plans are tested every two years during emergency exercises involving the plant staff and local, state, and, in some cases, federal agencies.

Occupational Radiation Safety - NRC regulations set a limit on radiation doses received by plant workers, and this cornerstone monitors the effectiveness of the plant's program to control and minimize those doses.

Public Radiation Safety - This cornerstone measures the procedures and systems designed to minimize radioactive releases from a nuclear plant during normal operations and to keep those releases within federal limits.

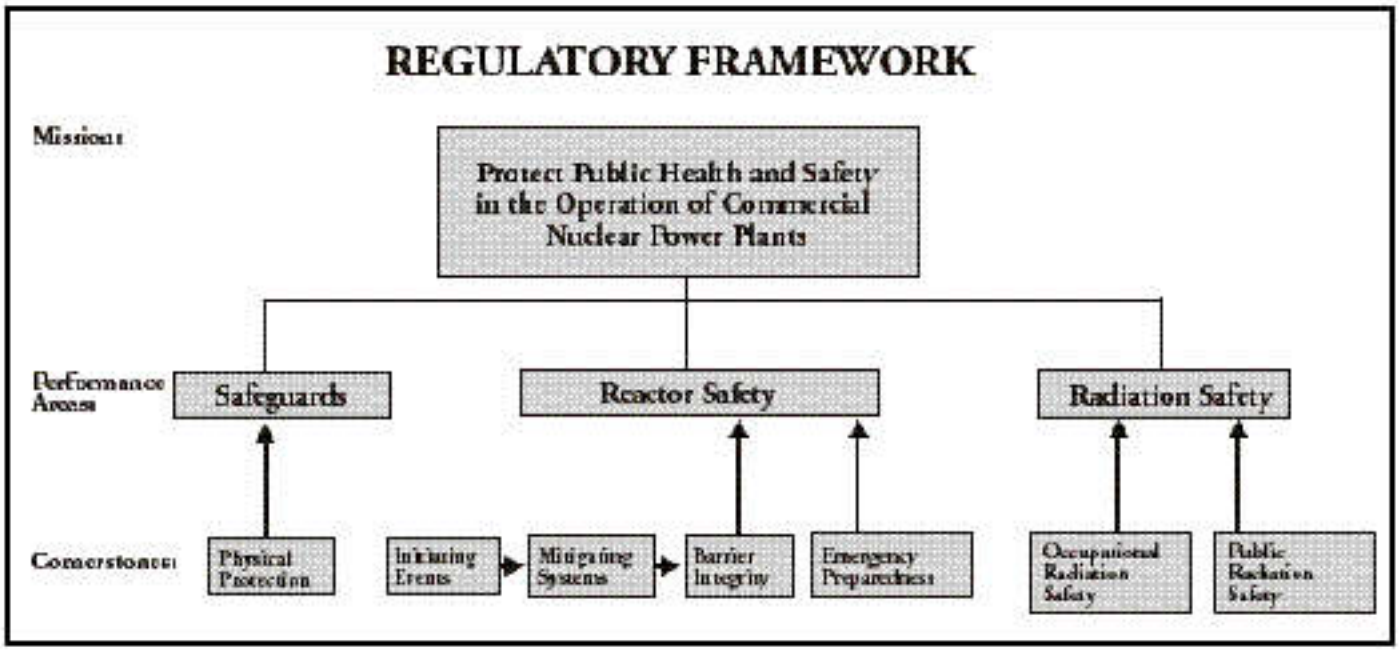
Physical Protection- Nuclear plants are required to have well-trained security personnel and a variety of protective systems to guard vital plant equipment, as well as programs to assure that employees are constantly fit for duty through drug and alcohol testing. This cornerstone measures the effectiveness of the security and fitness-for-duty programs.

In addition to the cornerstones, the reactor oversight program features three "cross-cutting" elements, so named because they affect and are therefore part of each of the cornerstones:

- ***Human performance***
- ***Management attention to safety and workers' ability to raise safety issues*** (The so-called "safety-conscious work environment")
- ***Finding and fixing problems*** (The utility's corrective action program)

The review and assessment of these cross-cutting elements have an important role in the new process. A diagram of this regulatory framework follows.

NRC Reactor Oversight Process



Measuring and Inspecting Nuclear Plant Performance

Nuclear plant performance is measured by a combination of objective performance indicators and by the NRC inspection program. These are closely focused on those plant activities having the greatest impact on safety and overall risk. In addition, the NRC conducts both periodic and annual reviews of the effectiveness of each utility's programs to identify and correct problems.

Performance indicators use objective data to monitor performance within each of the cornerstones. (See Table 1) The data which make up the performance indicators are generated by the utilities and submitted to the NRC on a quarterly basis. Each performance indicator is measured against established thresholds which are related to their effect on safety. Performance indicators are reviewed by the NRC staff and posted on the NRC's web site. While performance indicators can provide insights into plant performance for selected areas, the NRC's inspection program provides a greater depth and breadth of information for consideration by the NRC in assessing plant performance.

NRC Reactor Oversight Process

The inspection program is designed to verify the accuracy of performance indicator information and to assess performance that is not directly measured by the performance indicator data.

Table 1

Safety Cornerstones	Performance Indicator
Initiating Events	Unplanned reactor shutdowns (automatic and manual)
	Loss of normal reactor cooling systems following unplanned shutdown
	Unplanned events that result in significant changes in reactor power
Mitigating Systems	Safety Systems not available • Specific Emergency Core Cooling Systems • Emergency Electric Power Systems
	Safety System Failure
Integrity of Barriers to Release of Radioactivity	Fuel Cladding (measured by radioactivity in reactor cooling systems)
	Reactor cooling system leak rate
Emergency Preparedness	Emergency response organization drill performance
	Readiness of emergency response organization
	Availability of notification system for area residents
Occupational Radiation Safety	Compliance with regulations for controlling access to radation areas in plant
	Uncontrolled radation exposures to workers greater than 10 percent of regulatory limit
Public Radiation Safety	Effluent releases requiring reporting under NRC regulations and license conditions
Physical Protection	Security systems equipment availability
	Personnel screening program performance
	Employee fitness-for-duty program effectiveness

NRC Reactor Oversight Process

Using Performance Indicators

The performance indicator data are evaluated and integrated with findings of the NRC inspection program. Each of the performance indicators has criteria for measuring acceptable performance. (As in all industrial activities, nuclear power plants are not error-free or risk-free. Equipment problems and human errors will occur. Each performance indicator is designed to determine acceptable levels of operation within substantial safety margins.) These objective criteria are designed to reflect risk according to established safety margins, as indicated by a color coding system.

A "green" coding indicates performance within an expected performance level in which the related cornerstone objectives are met. "White" indicates performance outside an expected range of nominal utility performance but related cornerstone objectives are still being met. "Yellow" indicates related cornerstone objectives are being met, but with a minimal reduction in safety margin. "Red" indicates a significant reduction in safety margin in the area measured by that performance indicator. The performance indicators are reported to the NRC on a quarterly basis by each utility. Following compilation and review by the NRC staff, the performance indicators are posted at **www.nrc.gov/NRR/OVERSIGHT/ASSESS/index.html** on the NRC's web site.

Scope of Inspections

The revised oversight process continues to utilize a variety of NRC inspectors who monitor plant activities. The inspections are performed by NRC resident inspectors stationed at each nuclear power plant and by inspectors based in one of the four NRC regional offices or in NRC headquarters in Rockville, Maryland. The regional offices are in King of Prussia, Pennsylvania; Atlanta, Georgia; Lisle, Illinois; and Arlington, Texas.

The revised process includes baseline inspections common to all nuclear plants. The baseline inspection program, based on the "cornerstone" areas, focuses on activities and systems that are "risk significant," that is, those activities and systems that have a potential to trigger an accident, can mitigate the effects of an accident, or increase the consequences of a possible accident.

The baseline inspection program has three parts — inspection of areas not covered by performance indicators or where a performance indicator does not fully cover the inspection area; inspections to verify the accuracy of a licensee's reports on performance indicators; and a thorough review of the utility's effectiveness in finding and resolving problems on its own.

The inspection program also reviews the "cross-cutting issues" of human performance, the "safety-conscious work environment," and how the utilities find and fix problems. Inspections beyond the baseline are performed at plants with performance below established thresholds, as assessed through information gained from performance indicators and NRC inspections. Additional inspections may also be performed in response to a specific event or problem which may arise at a plant.

The new inspection program uses a "risk-informed" approach to select areas to inspect within each cornerstone. The inspection areas were chosen because of their importance from the point of view of potential risk, past operational experience, and regulatory requirements.

Inspection reports are issued for all inspections just as under the previous inspection program. The reports are available to the public on the NRC's internet web site and from its Public Document Room at NRC headquarters.

NRC Reactor Oversight Process

Assessing Plant Performance

The inspection staff has developed a procedure, called the "Significance Determination Process," to help inspectors determine the safety significance of inspection findings. This process is used for an initial screening review to identify those inspection findings that would not result in a significant increase in risk and thus need not be analyzed further (a "green" finding). Remaining inspection findings — which may have an effect on plant risk — are then subject to a more thorough risk assessment, using the next phase of the Significance Determination Process. This more detailed assessment may involve NRC risk experts from the appropriate regional office and further review by the utility's plant staff. The final outcome of the review — evaluating whether the finding is green, white, yellow, or red — is used to determine what further NRC action may be called for.

Each calendar quarter, the resident inspectors and the inspection staff in the regional office review the performance of all nuclear power plants in that region, as measured by the performance indicators and by inspection findings. Every six months, this review is expanded to include planning of inspections for the following 12-month period.

Each year, the final quarterly review involves a more detailed assessment of plant performance over the previous 12 months and preparation of a performance report, as well as the inspection plan for the following year. This review includes NRC headquarters staff members, the regional staff, and the resident inspectors.

These annual performance reports are available to the public on the agency's web site. In addition the NRC staff holds public meetings with utilities to discuss the previous year's performance at each plant.

In addition, NRC senior management reviews the adequacy of agency actions for plants with significant performance problems. The managers also take a wider view both of the overall industry performance and of the performance of the agency's regulatory programs. The performance of plants requiring heightened agency scrutiny will then be discussed during a public meeting with the NRC Commissioners at the agency's Rockville, Maryland, headquarters.

How the NRC Will Respond to Plant Performance

The quarterly reviews of plant performance, using both the performance indicators and inspection findings, determines what additional action, if any, the NRC will take if there are signs of declining performance. This approach to enforcement is intended to be more predictable than previous practices by linking regulatory actions to performance criteria. The new process utilizes four levels of regulatory response with NRC regulatory review increasing as plant performance declines. The first two levels of heightened regulatory review are managed by the appropriate regional office. The next two levels call for an agency response, involving senior management attention from both headquarters and regional offices.

The oversight program retains the same tools used in the past for dealing with declining plant performance and violations. These tools, however, are used in a more predictable manner that is commensurate with the decreased safety performance.

NRC Reactor Oversight Process

In the past, the NRC tended to use fines as a prime indicator of agency concern and as a motivator to affect licensee corrective actions. Under the new approach, there is a system of specified agency actions if performance declines. These are indicated in the agency "Action Matrix." Fines will generally be reserved for such things as discriminating against workers raising safety concerns, or willful misreporting of required information.

The NRC's actions for performance below the "green" level may include meetings with the utility, additional inspections, and required reviews and response by the utility. Further declines in performance would warrant stronger action by the NRC, including a civil penalty, order or even the suspension of the utility's operating license. Table 2 summarizes the levels of NRC's response to plant performance.

Violations of NRC Requirements

Each violation of NRC requirements found during NRC inspections is evaluated to determine its effect on plant safety and risk. If the violation is of very low safety significance, it will be discussed in the inspection report with no formal enforcement action. The utility is expected to deal with the violation through its corrective action program, correcting the violation and taking steps to prevent a recurrence. The issue may also be reviewed during future NRC inspections.

If the NRC risk evaluation finds that the violation has higher safety significance, a Notice of Violation will be issued. A Notice of Violation may also be issued if the utility fails to correct a violation of low safety significance in a reasonable period of time or if a violation is found to be willful.

The Notice of Violation requires the utility to respond formally to the NRC with its actions to correct the violation and what steps it will take to prevent the violation from occurring again. The agency will then review the utility's actions in a later inspection.

Normally, these violations are not the subject of a fine. However, there may be violations that warrant a fine because of their unusual significance. These violations are likely to be uncommon. Possible examples include exceeding a safety limit specified in a reactor license or the inadvertent startup of a reactor.

In addition, some violations call for the traditional enforcement approach, including the possible issuance of fines. Examples include:

- Discrimination against workers for raising safety issues or other willful violations.
- Actions that may adversely affect the NRC's ability to monitor utility activities, including failure to report required information, failure to obtain NRC approval for plant changes, failure to maintain accurate records, or failure to provide the NRC with complete and accurate information.
- Incidents with actual safety consequences, including radiation exposures above NRC limits, releases of radioactive material above NRC limits, or failure to notify government agencies when an emergency response is required.

NRC Reactor Oversight Process

Table 2

Assessment of Plant Performance (in order of increasing safety significance)	NRC Response
I. All performance indicators and cornerstone inspection findings GREEN • Cornerstone objectives fully met	• Routine inspector and staff interaction • Baseline inspection program • Annual assessment public meeting
II. No more than two WHITE inputs in different cornerstones • Cornerstone objectives fully met.	**Response at Regional level** • Staff to hold public meeting with utility management • Utility corrective action to address WHITE inputs • NRC inspection followup on WHITE inputs and corrective action
III. One degraded cornerstone (two WHITE inputs or one YELLOW input or three WHITE inputs in any performance area) • Cornerstone objectives met with minimal reduction in safety margin	**Response at Regional level** • Senior regional management to hold public meeting with utility management • Utility to conduct self-assessment with NRC oversight • Additional inspections focused on cause of degraded performance
IV. Repetitive degraded cornerstone, multiple degraded cornerstones, or multiple YELLOW inputs, or one RED input • Cornerstone objective met with longstanding issues or significant reduction in safety margin	**Response at Agency level** • Executive Director for Operations holds 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, Confirmation Action Letter, or Order
V. Unacceptable reduction • Unacceptable reduction in safety margin	**Response at Agency level** • Plant not permitted to operate • Commission meeting with senior utility management • Order to modify, suspend, or revoke license

NRC Reactor Oversight Process

How This New Oversight Process Differs from the Previous Approach

The previous oversight process evolved over a period of time when the nuclear power industry was less mature and there was less operational experience on which to base rules and regulations. Very conservative judgments governed the rules and regulations. Significant plant operating events occurred with some frequency, therefore the oversight process tended to be reactive and prescriptive, closely observing plant performance for adherence to the regulations and responding to operational problems as they occurred.

But we now have the benefit of four decades of operational experience and, generally speaking, steadily improving plant performance, particularly over the last decade or so. The new program focuses more of the agency's resources on the relatively small number of plants which evidence performance problems. The baseline inspection program is considered the minimum inspection effort needed to assure that plants meet the "safety cornerstone" objectives. The baseline inspection program is performed at all reactor sites by NRC resident inspectors and inspectors from the regional offices.

Plants which do not meet the "safety cornerstone" objectives, measured by performance indicators and inspection findings, receive increased inspection, focusing on areas of declining performance. There are also inspections beyond the baseline program, even at plants performing well, if there are operational problems or events the NRC believes require greater scrutiny. Generic problems, affecting some or all plants, may also require additional inspections.

The previous oversight program relied more heavily on fines when violations occurred, while the new program makes broader use of other enforcement tools such as orders and other formal regulatory actions. When fines were imposed previously, they were often issued long after the violations occurred and their impact was substantially less than the cost of repairs or the costs associated with a shutdown to correct the violations. The new process is intended to be more effective in correcting performance or equipment problems because the agency's response is both more timely and more predictable.

The new assessment program is substantially different from the previous one. It makes greater use of objective performance indicators. Together, the indicators and inspection findings provide the information needed to support reviews of plant performance, to be conducted on a quarterly basis, with the results posted at **www.nrc.gov/NRR/OVERSIGHT/ASSESS/index.html** on the NRC's web site.

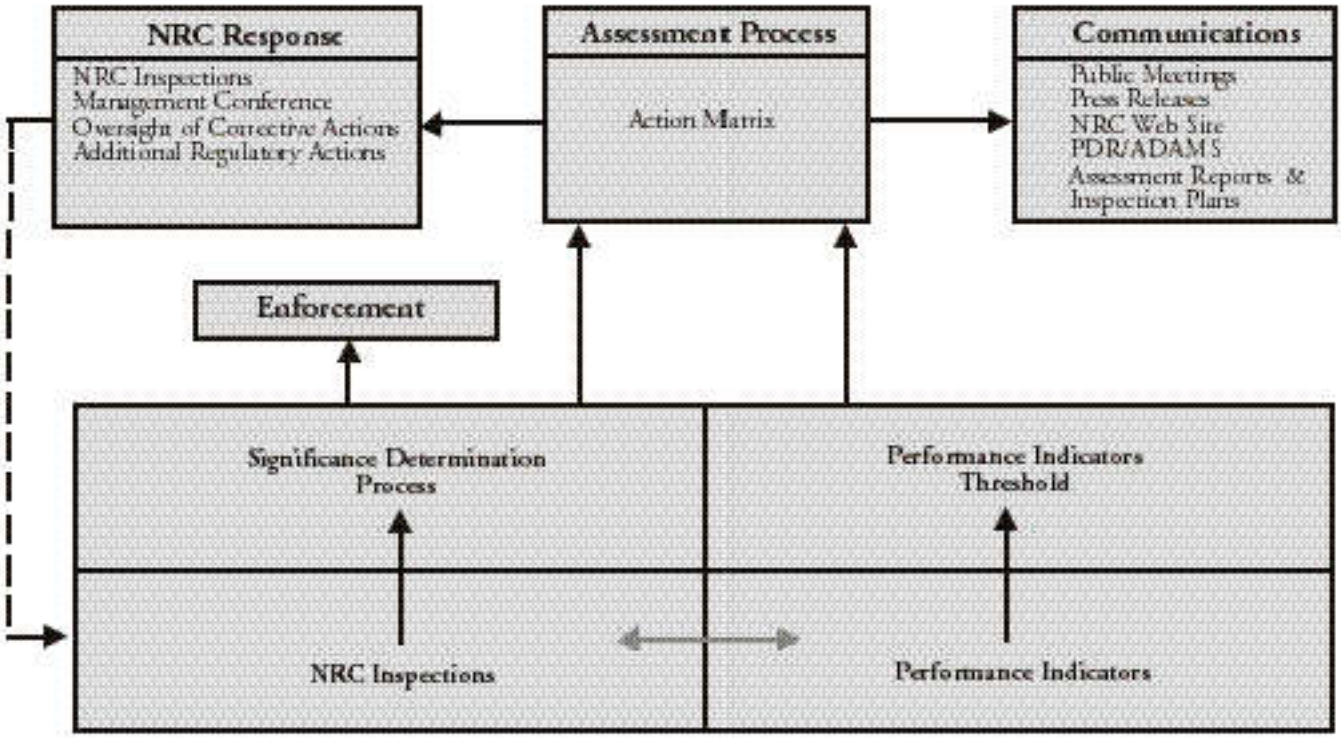
NRC Reactor Oversight Process

The new assessment process also features expanded reviews on a semi-annual basis to include inspection planning and a performance report, all of which are posted on the NRC's web site. The new oversight process is depicted below.

The performance assessment process previously involved three processes:

- ***Plant Performance Review***-Conducted every six months to assess events, inspection findings, and other data. This review was done to plan future inspections and to identify those plants with declining performance that required further NRC action.
- ***Senior management meetings***-Twice a year, NRC senior managers reviewed information assessing plant performance to discuss what regulatory action was needed at plants with declining performance. The managers designated those plants warranting heightened NRC monitoring as being on a "watch list." These "watch list" plants were then discussed at a public meeting with the Commission.
- ***Systematic Assessment of Licensee Performance*** (SALP) - Every 12 to 24 months, the NRC staff performed a separate review of the performance of each plant, preparing a Systematic Assessment of Licensee Performance report. This report included a numerical rating of the plant in four categories — plant operations, maintenance, engineering, and plant support — as well as a narrative discussion of performance in each area.

REACTOR OVERSIGHT PROCESS



NRC Reactor Oversight Process

Making Performance Information Available to the Public

The revised oversight process provides more information on plant performance than in the past, and the information is available on a more frequent basis. This information is placed on the NRC's internet web site as well as in its Public Document Room at NRC headquarters.

A utility submits to the NRC the quarterly performance indicator data for each nuclear power plant it operates. The NRC staff reviews the data for completeness and accuracy and evaluates inspection findings to determine their safety significance. This review uses the agency's "Significance Determination Process," which is keyed to how plant safety systems and procedures contribute to the risk of a potential accident.

The performance indicators and the assessment of inspection findings are placed on the NRC web site using the color notation of their significance — green, white, yellow, or red. The statistics and inspection findings which underlie the color notation are also posted on the web site.

The revised oversight process is intended to fulfill the following four goals established by the Commission:

1. To maintain safety by establishing a regulatory oversight framework that provides assurance that plants continue to be operated safely by plant operators. Maintaining safety is the NRC's overarching mission.
2. To enhance public confidence in the NRC's regulatory program by increasing the predictability, consistency, objectivity and transparency of the oversight process so that all parties are well served by the changes taking place.
3. To improve the effectiveness, efficiency, and realism of the oversight process by focusing both agency resources and utility resources on those issues with the most safety-significance.
4. To reduce unnecessary regulatory burden as the process becomes more efficient and effective.

Plant Performance Information on the Web

Information on a nuclear plant's recent performance is posted quarterly on the NRC's internet web site. You can access this information on your personal computer or on a computer in a public library, school, or other location.

This information includes the performance indicators — the safety data submitted by the utility in key areas of plant operation — and NRC inspection findings.

NRC Reactor Oversight Process

To access this information on the web, follow these steps.

Step 1: Plant Index

Enter this web address:
http://www.nrc.gov/NRR/OVERSIGHT/ASSESS/index.html
which will take you to the Reactor Assessment web pages.

A listing of all the nuclear plant sites is in the window on the left side of the screen.

Find the plant name in the index. Click on it to go to the plant assessment information.

Step 2: Performance Indicators

You will then see the top layer of information, shown first on the web page, which gives a general view of the plant's performance. Each performance indicator and each category of inspection findings is shown with a color coding: green, white, yellow, or red (with gray showing no data for that period). Green indicates that performance is acceptable and no additional NRC oversight is needed. White and yellow ratings will trigger additional regulatory action at the regional or agency level. Red ratings in multiple areas would represent unacceptable performance and may require a plant shutdown.

This color coding, however, is just the beginning of the information available on the web site.

On the computer screen, if you click on the performance indicator box, you will go to the information underlying that assessment. For the performance indicators, you will see the specific data which go into the performance indicator. These data — in table and chart form — cover up to a two-year period to show any trend and to provide a historical perspective.

Step 3: Inspection Findings

The inspection findings are on the same screen as the performance indicators — simply scroll down the page until the findings are displayed. The findings use the same color coding as the performance indicators to show their safety significance.

Clicking on the colored box will take you to a screen with a description of what the NRC inspectors found.

There may also be another box to access inspection details that do not fit into the cornerstone categories.

After each inspection finding — which is marked with an icon indicating the safety assessment color coding — there is a link to the entire inspection report that includes the finding. This report is in Adobe Acrobat (pdf) format, a standard document format readable in Windows, Macintosh, and other computer formats. Most computers include the Adobe Acrobat Reader. If you do not have it, it is available at no cost at **http://www.adobe.com** on the internet.

NRC Reactor Oversight Process

Glossary

Baseline Inspection Program-The normal inspection program performed at all nuclear power plants. The program focuses on plant activities that are not adequately measured by performance indicators, on the corrective action program, and on verifying the accuracy of the performance indicators.

Corrective Action Program-The system by which a utility finds and fixes problems at the nuclear plant. It includes a process for evaluating the safety significance of the problems, setting priorities in correcting the problems, and tracking them until they have been corrected.

Cross-Cutting Area-Nuclear plant activity that affects most or all safety cornerstones. These include the plant's cornerstone action program, human performance, and "safety- conscious work environment."

Inspection Reports-Reports are issued periodically to document inspection findings. These may cover a specific time period for the baseline inspection or a particular event or problem examined in a reactive inspection. All inspection reports are public documents and, when issued, are posted to the NRC's internet web site.

Performance Indicator-Objective data which record performance in a specific cornerstone of safety at a nuclear power plant.

Reactive Inspection-An inspection to examine the circumstances surrounding an operational problem or event occurring at a nuclear plant.

Regulatory Conference-A meeting between the NRC staff and a utility to discuss potential safety issues or to discuss a change in performance as indicated by a declining performance indicator or inspection finding. These meetings are open to public observation unless they cover security issues, NRC investigation findings, or similar sensitive topics.

Resident Inspector-An NRC inspector assigned to a nuclear plant on a full-time basis. Each site has at least two resident inspectors.

Risk-Informed-Incorporating an assessment of safety significance or relative risk in NRC regulatory actions.

Safety Cornerstones-Nuclear plant activities that are essential for the safe operation of the facility. These cornerstones are grouped under the categories of reactor safety, radiation safety, and safeguards.

Safety-Conscious Work Environment-A working environment in which employees are encouraged to report safety concerns without fear of criticism or retaliation from their supervisors because they raised the issue.

Significance Determination Process-The process used by the NRC staff to evaluate inspection findings to determine their safety significance. This involves assessing how the inspection findings affect the risk of a nuclear plant accident, either as a cause of the accident or the ability of plant safety systems or personnel to respond to the accident.

Office of Public Affairs

U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
Telephone: 301/415-8200

NUREG-1649, Rev. 3
July 2000