PERFORMANCE INDICATORS

PHILOSOPHY

- PIs Should be Based on Objective Data
- They Should Provide a Measure of Licensee Performance
- Degree of Regulatory Response to PIs is a Function of Risk Significance
- PIs and Inspection Findings Should be treated in an Equivalent Manner

USE OF RISK MODELS TO ESTABLISH LEVEL OF REGULATORY INVOLVEMENT

- To Establish Bands of Risk Significance for PIs and Inspection Findings.
- To Develop the Significance Determination Process for Findings Related to Initiating Events, Mitigating Systems, and Containment System.
- CDF and LERF used as risk metrics.

RISK SIGNIFICANCE OF PIs AND INSPECTION FINDINGS FOR REACTOR SAFETY CORNERSTONES

- Intent in Setting up Scheme for Assessing Risk Significance of PIs and Inspection Findings Was to Establish Some Sort of Equivalence Using PRA Models.

- Increases in PI Values, If Maintained, Would Correspond to Increases in CDF over and above the Base CDF.

RISK SIGNIFICANCE OF PIs AND INSPECTION FINDINGS FOR REACTOR SAFETY CORNERSTONES

- Inspection Findings That Can Be Identified with a Degradation in Performance of a Mitigating System or Can Lead to an Increased Likelihood of an Initiating Event Can Be Characterized by the Change in CDF and Possibly LERF.

- Inspection Findings That Can Be Identified with a Degradation of the Containment Function Can Be Characterized by the Change in LERF.

RISK SIGNIFICANCE OF PIs AND INSPECTION FINDINGS FOR REACTOR SAFETY CORNERSTONES

- The Acceptance Guidelines of RG 1.174 on Changes to CDF and LERF Are Used to Establish Bands That Determine the Degree of Regulatory Involvement - the Higher the Risk Impact of the PI Value or the Inspection Finding the More Regulatory Involvement.

THRESHOLDS FOR PIs

- The Green-White Threshold Was Determined by Experience Data Such That Only a Few Outlier Values Would Be in the White.

- The White-Yellow Threshold Was Established at a Value Such That a Change of the PI Would Result in a Δ CDF > 1E-05.

- The Yellow-Red Threshold Was Established Such That a Change in PI Value Greater than the Threshold Would Result in a Δ CDF > 1E-04.

- The Thresholds Were Established Using a Set of PRA Models with the Lower Threshold from the Set Being Used.

Typical PWR AFW System Unavailability

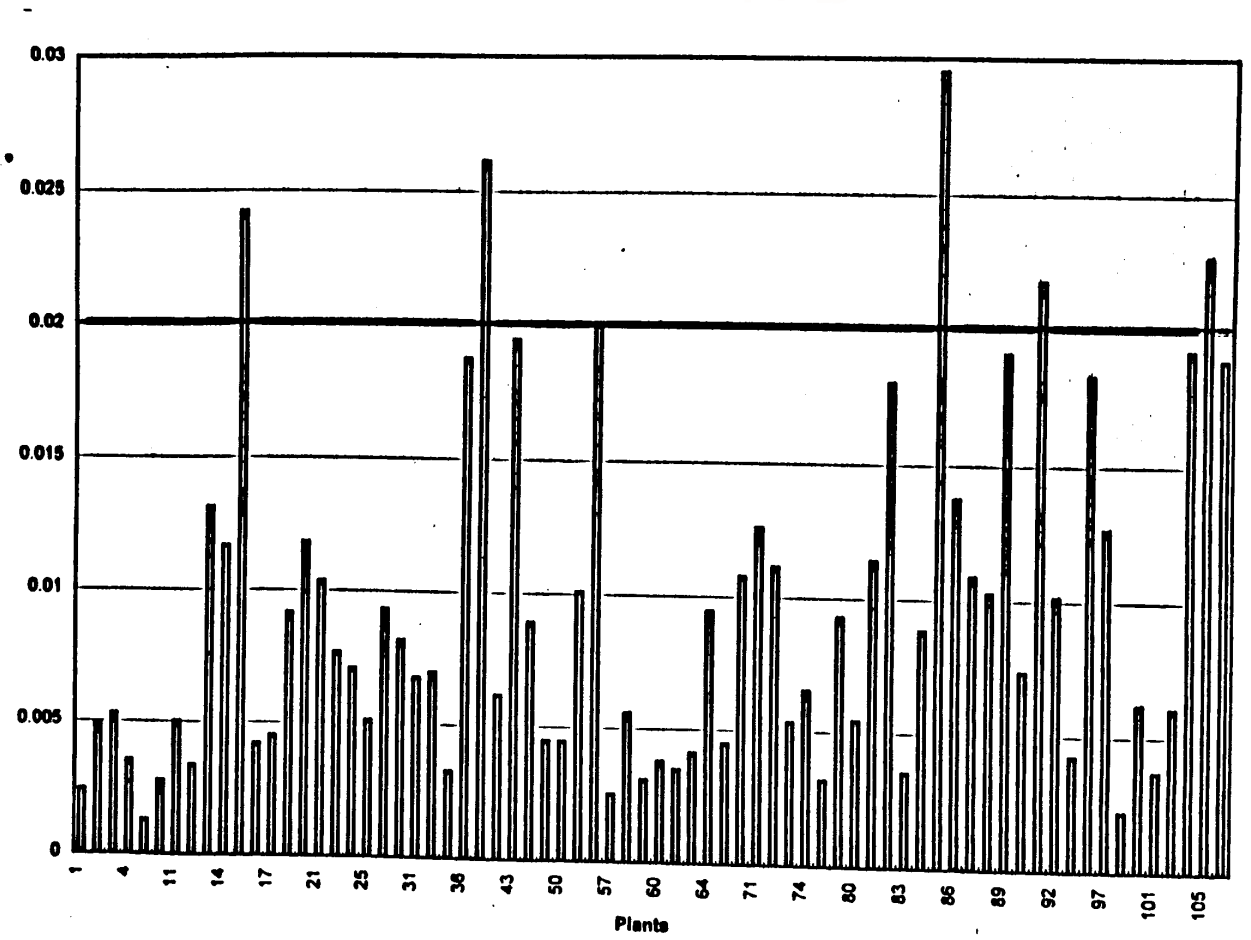


Table 1 – PERFORMANCE INDICATORS

Cornerstone	Indicator		Thresholds (see Note 1)		
			Increased Regulatory Response Band	**Required Regulatory Response Band**	**Unacceptable Performance Band**
Initiating Events	Unplanned Scrams per 7000 Critical Hours (automatic and manual scrams during the previous four quarters)		>3.0	>6.0	>25.0
	Scrams with a Loss of Normal Heat Removal (over the previous 12 quarters)		>2.0	>10.0	>20.0
	Unplanned Power Changes per 7000 Critical Hours (over previous four quarters)		>6.0	N/A	N/A
Mitigating Systems	Safety System Unavailability (SSU) (average of previous 12 quarters)	**All Plants**			
		≤2EDG	>2.5%	>5.0%	>10.0%
		>2EDG	>2.5%	>10.0%	>20.0%
		Hydro Emerg. Power	TBD	TBD	TBD
		BWRs			
		HPCI	>4.0%	>12.0%	>50.0%
		HPCS	>1.5%	>4.0%	>20.0%
		RCIC	>4.0%	>12.0%	>50.0%
		RHR	>1.5%	>5.0%	>10.0%
		PWRs			
		HPSI	>1.5%	>5.0%	>10.0%
		AFW	>2.0%	>6.0%	>12.0%
		RHR	>1.5%	>5.0%	>10.0%
	Safety System Functional Failures (over previous four quarters)	BWRs	>6.0	N/A	N/A
		PWRs	>5.0	N/A	N/A

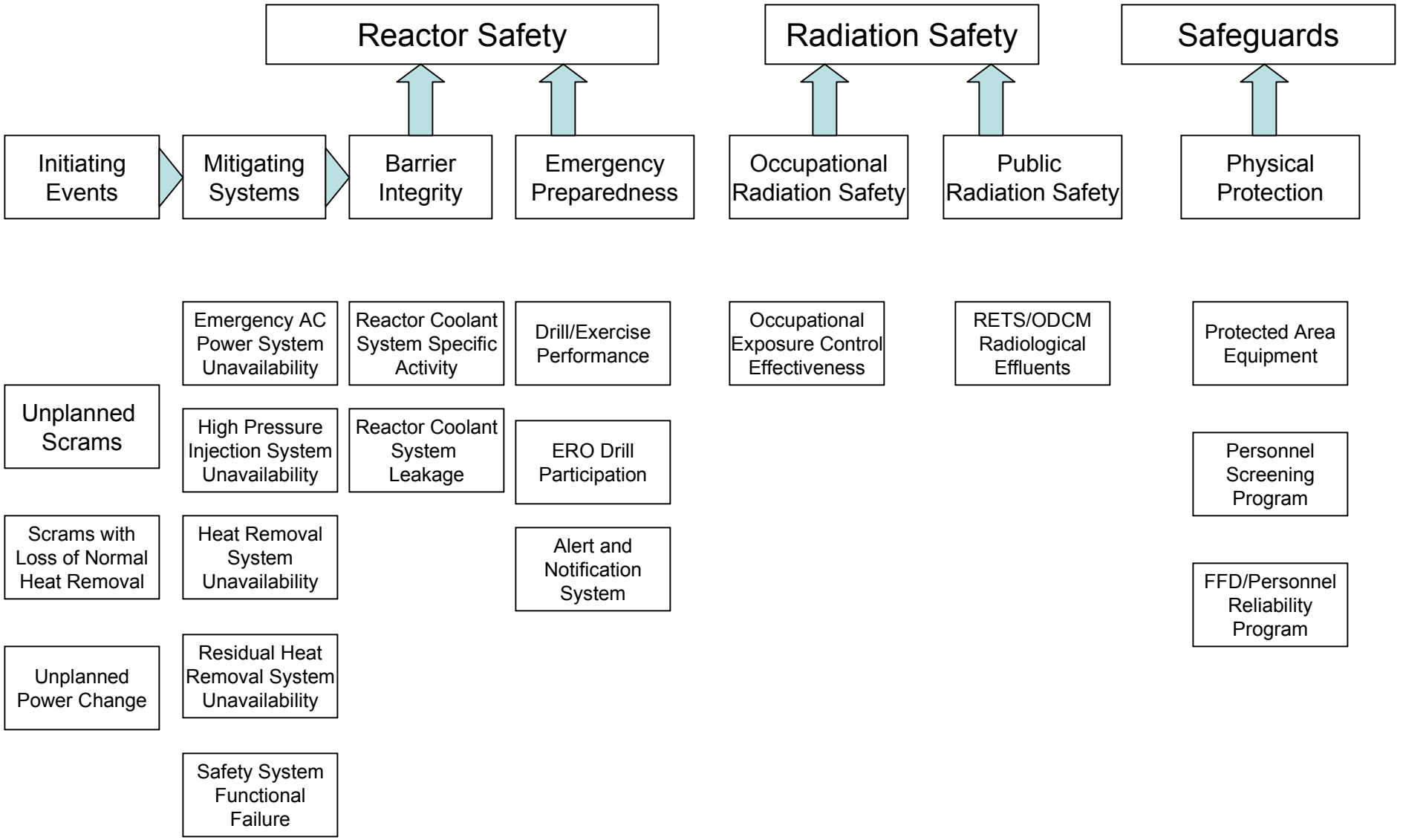
Note 1: Thresholds that are specific to a site or unit will be provided in Appendix D when identified.

THRESHOLDS FOR INSPECTION FINDINGS

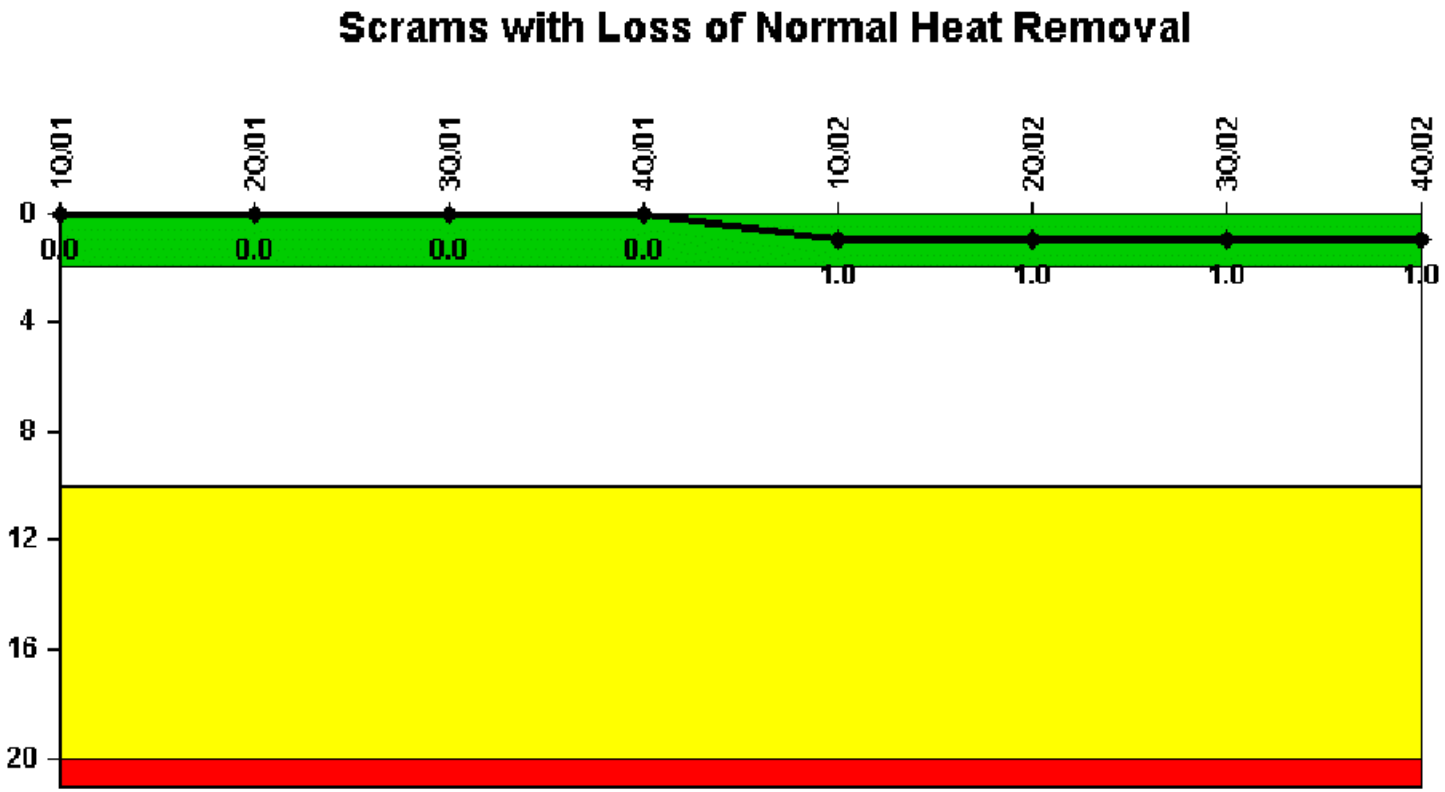
- The Green-White, White-Yellow, and Yellow-Red Thresholds Are Set to Coincide with Δ CDF > 1E-06, 1E-05, and 1E-04, Respectively.

- The Significance of an Inspection Finding Is Assessed Using the Significance Determination Process (SDP).

Performance Indicators in the Seven Cornerstones

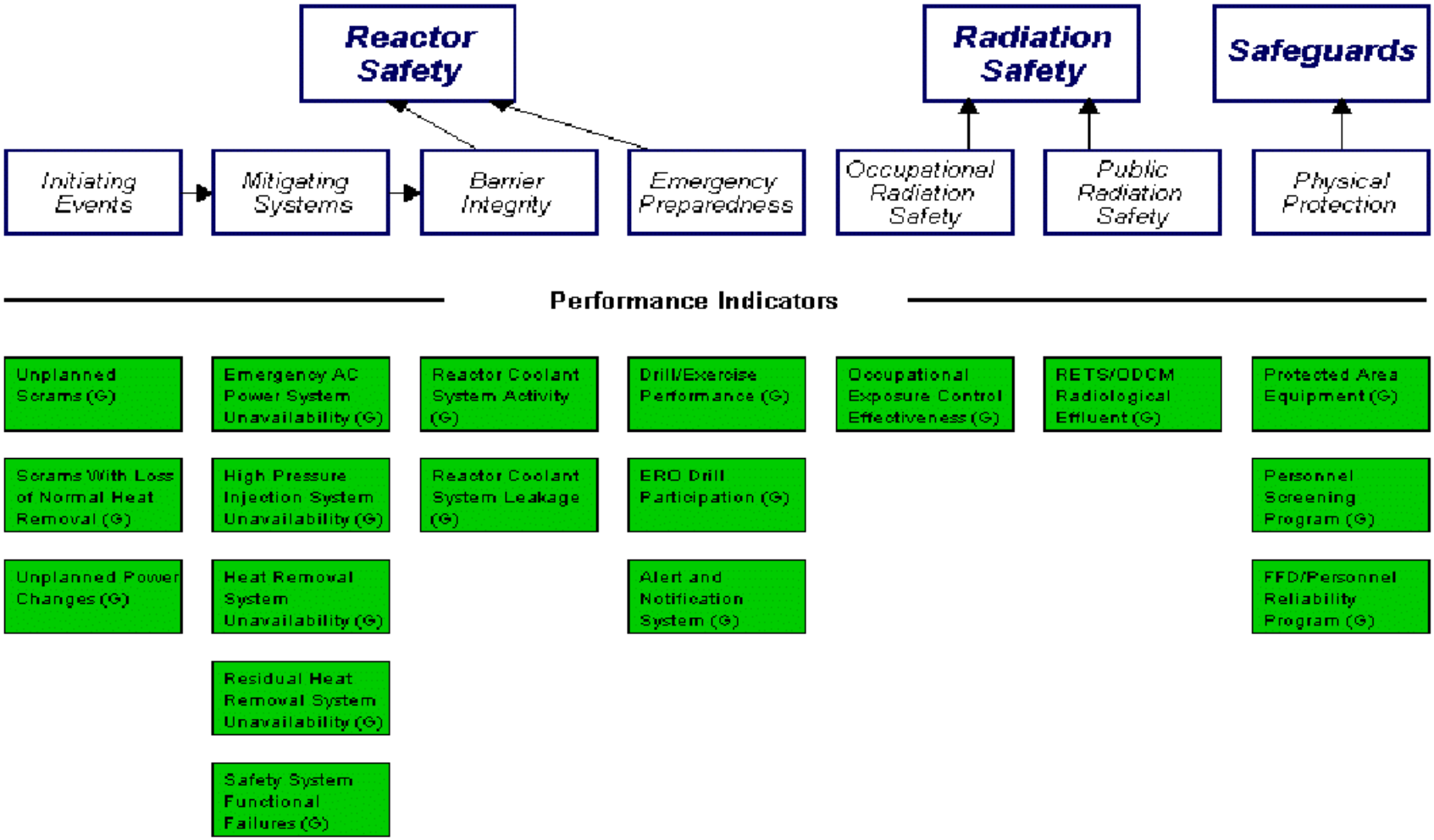


TYPICAL PERFORMANCE INDICATOR



Thresholds: White > 2.0 Yellow > 10.0 Red > 20.0

4Q PERFORMANCE INDICATORS



Performance Indicators (Risk Bases, Reporting, Measurement)

Cornerstone: Initiating Events:

- **Unplanned Scrams**

  Risk Basis: White/Yellow and Yellow/Red determined using risk-sensitivity studies (SECY-99-007, Attachment 2, Appendix H)

  Measurement: $\frac{\text{(total unplanned srams while critical in the previous 4 qtrs)(7000 hrs)}}{\text{(total number of hours critical in the previous 4 qtrs)}}$

  The value of 7,000 hours is used because it represents one year of reactor operations at an 80.0% capacity factor.

  Reporting Requirement: Quarterly

Performance Indicators (Risk Bases, Reporting, Measurement)

Cornerstone: Initiating Events

- **<u>Unplanned Scrams with Loss of Normal Heat Removal</u>**

  Risk Basis: White/Yellow and Yellow/Red determined using risk-sensitivity studies (SECY-99-007, Attachment 2, Appendix H)

  Measurement: total unplanned scrams while critical in the previous 12 quarters that were either caused by or involved a loss of the normal heat removal path through the main condenser prior to establishing reactor conditions that allow use of the plant's normal long term heat removal systems.

  Reporting Requirement: Quarterly

Performance Indicators (Risk Bases, Reporting, Measurement)

Cornerstone: Initiating Events

- **Unplanned Power Changes per 7000 Critical Hours**

  Risk Basis: Threshold determined using industry mean plus one standard of deviation based on data from July 1, 1995, through June 30, 1997

  Measurement: $\frac{\text{(total \# of unplanned pwr changes during the previous 4 qtrs)(7000 hrs)}}{\text{(total number of hours critical during the previous 4 qtrs)}}$

  The value of 7,000 hours is used because it represents one year of reactor operations at an 80.0% capacity factor.

  Reporting Requirement: Quarterly

Performance Indicators (Risk Bases, Reporting, Measurement)

Cornerstone: Mitigating Systems

- **Emergency AC Power System Unavailability**
- **High Pressure Injection System Unavailability**
- **Heat Removal System Unavailability**
- **Residual Heat Removal System Unavailability**

Risk Basis: White/Yellow and Yellow/Red determined using risk-sensitivity studies (SECY-99-007, Attachment 2, Appendix H)

Measurement: $\frac{\text{(planned unavail hrs) + (unplanned unavail hrs) + (fault exposure unavail hrs)}}{\text{(hours train required during the previous 12 quarters)}}$

Reporting Requirement: Quarterly

Performance Indicators (Risk Bases, Reporting, Measurement)

Cornerstone: Mitigating Systems

- **Safety System Functional Failures**

  Risk Basis: Threshold determined using industry mean plus one standard of deviation based on data from July 1, 1995, through June 30, 1997

  Measurement: number of safety system failures in previous 4 qtrs

  Reporting Requirement: Quarterly

Performance Indicators (Risk Bases, Reporting, Measurement)

Cornerstone: Barrier Integrity

- **Reactor Coolant System Specific Activity**
- **Reactor Coolant System Leakage**

Risk Basis: Threshold based on regulatory basis; threshold set at 50 and 100 percent of technical specification limit.

Measurement: $\frac{\text{maximum monthly value of calculated activity}}{\text{Technical Specification limit}} \times 100$

$\frac{\text{maximum monthly value of identified leakage}}{\text{Technical Specification limit}} \times 100$

Reporting Requirement: Quarterly

Performance Indicators (Risk Bases, Reporting, Measurement)

Cornerstone: Emergency Preparedness

- **Drill/Exercise Performance**

Risk Basis: Threshold determined using analysis of emergency preparedness exercise inspection findings from 1994 to 1997.

Measurement: $\frac{\text{\# of timely \& accurate classifications, notifications, \& PARS from drills, exercises and actual events during the previous 8 quarter}}{\text{The total opportunities to perform classifications, notifications \& PARs during the previous 8 quarters}} \times 100$

Reporting Requirement: Quarterly

Performance Indicators (Risk Bases, Reporting, Measurement)

Cornerstone: Emergency Preparedness

- **ERO Drill Participation**

Risk Basis: Based on NRC staff and industry representative experiences

Measurement: # of key ERO members that have participated in a drill, exercise or actual event during the previous 8 quarters / Total number of key ERO members X 100

Reporting Requirement: Quarterly

Performance Indicators (Risk Bases, Reporting, Measurement)

Cornerstone: Emergency Preparedness

- **Alert and Notification System**

Risk Basis: Threshold determined by analysis of yearly sirens availability for 19995, 1996 and 1997 for approximately 20 plants

Measurement: $\frac{\text{\# of successful siren tests in the previous 4 quarters}}{\text{total number of siren tests in the previous 4 quarters}} \times 100$

Reporting Requirement: Quarterly

Performance Indicators (Risk Bases, Reporting, Measurement)

Cornerstone: Occupational Radiation Safety

- **Occupational Exposure Control Effectiveness**

Risk Basis: Threshold based on a review and analysis of quarterly occupational radiological occurrence data provided by 28 licensee sites for the period January 1996 through September 1998.

Measurement: Sum of reported number of occurrences for each of the following:

- technical specification high radiation area (> 1 rem per hour) occurrence
- very high radiation area occurrences
- unintended exposure occurrences\

Reporting Requirement: Quarterly

Performance Indicators (Risk Bases, Reporting, Measurement)

Cornerstone: Public Radiation Safety

- **RETS/ODCM Radiological**

Risk Basis: Threshold based on a review of licensee event report data associated with process radiation monitoring system activities provided by all sites for the period from January 1995 through December 1997.

Measurement: Number of RETS/ODCM radiological effluent occurrences per site in the previous four quarters.

Reporting Requirement: Quarterly

Performance Indicators (Risk Bases, Reporting, Measurement)

Cornerstone: Physical Protection

- **Protected Area Equipment**

Risk Basis: Threshold was developed and agreed to by an expert panel composed of NRC and industry representatives, based on the collection and review of historical data.

Measurement:

$$\text{IDS unavailability index} = \frac{\text{IDS Compensatory hrs in the prev. 4 quarters}}{\text{(IDS normalization factor) X 8760 hours}}$$

$$\text{CCTV unavailability index} = \frac{\text{CCTV compensatory hrs in the prev. 4 quarters}}{\text{(CCTV normalization factor) X 8760 hours}}$$

$$\text{Indicator value} = \frac{\text{IDS unavailability index} + \text{CCTV unavailability index}}{2}$$

Reporting Requirement: Quarterly

Performance Indicators (Risk Bases, Reporting, Measurement)

Cornerstone: Physical Protection

- **Personnel Screening Program**

Risk Basis: Threshold was developed and agreed to by an expert panel composed of NRC and industry representatives, based on the collection and review of historical data.

Measurement: Number of reportable failures to properly implement the regulatory requirements

Reporting Requirement: Quarterly

Performance Indicators (Risk Bases, Reporting, Measurement)

Cornerstone: Physical Protection

- **FFD/Personnel Reliability Program**

  Risk Basis: Threshold was developed and agreed to by an expert panel composed of NRC and industry representatives, based on the collection and review of historical data.

  Measurement: The number of reportable failures to properly implement the requirements of 10 CFR Part 26 and 10 CFR 73.56.

  Reporting Requirement: Quarterly

Overall Results
Performance Indicators that crossed thresholds

	WHITE		
C/S	4/2/00 to 4/1/01	4/2/01 to 12/31/01	1/1/02 to 9/30/02
IE	7	4	3
MS	14	4	3
B	2	1	0
EP	5	0	1
RP(O)	0	0	0
RP(P)	0	0	0
PP(1)	2	0	0
Total	30	9	6

	YELLOW		
C/S	4/2/00 to 4/1/01	4/2/01 to 12/31/01	1/1/02 to 9/30/02
IE	0	0	0
MS	0	0	0
B	0	0	0
EP	0	0	0
RP(O)	0	0	0
RP(P)	0	0	0
PP(1)	0	0	0
Total	0	0	0

INDUSTRY TRENDS

- NRC monitors PIs at the industry-level to assess whether there are any adverse trends in performance

- Annual report to Congress of any adverse trends

- Indicators posted on NRC web site

http://www.nrc.gov/reactors/operating/oversight/industry-trends.html

PERFORMANCE INDICATOR (PI) PROGRAM CHALLENGES

- Address inconsistencies between the ROP maintenance rule, INPO, and WANO requirements (primarily the safety system unavailability PI)
- Safety System Unavailability PI
- Improve the physical protection PI
- Initiating Events PI
- Develop improved barrier integrity PIs.

SAFETY SYSTEM UNAVAILABILITY

- Issues
  - Thresholds are the same for all plants, and do not take into account plant specific differences in risk importance
  - Failures are addressed via the ‘fault exposure time’ which can produce step changes in PI values
- One proposed resolution is the MSPI – mitigating system performance indicator – currently under consideration