



PERFORMANCE INDICATORS

PHILOSOPHY

- Pls Should be Based on Objective Data
- They Should Provide a Measure of Licensee Performance
- Degree of Regulatory Response to Pls is a Function of Risk Significance
- Pls 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 $\Delta \text{CDF} > 1\text{E-}05$.
- The Yellow-Red Threshold Was Established Such That a Change in PI Value Greater than the Threshold Would Result in a $\Delta \text{CDF} > 1\text{E-}04$.
- The Thresholds Were Established Using a Set of PRA Models with the Lower Threshold from the Set Being Used.

Typical PWR AFW System Unavailability

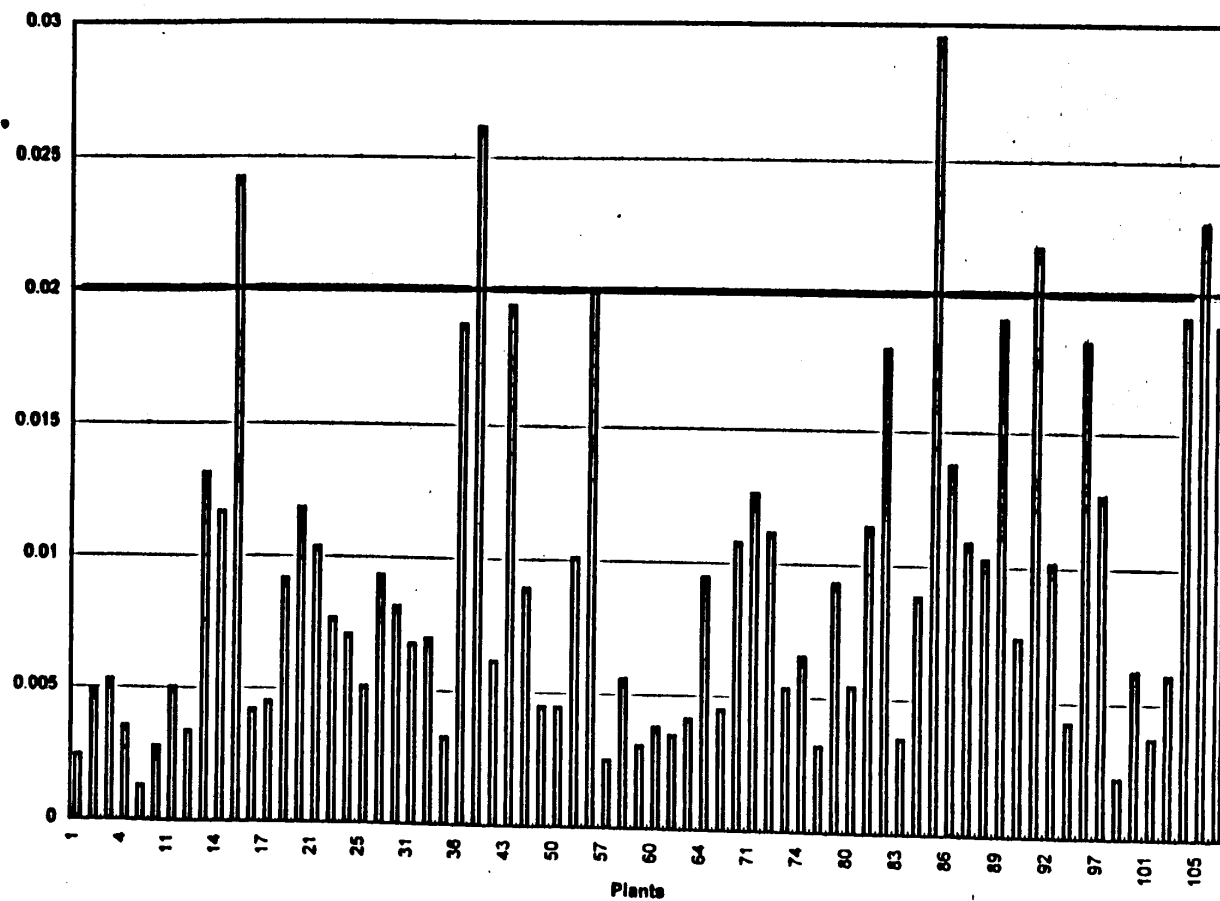


Table 1 – PERFORMANCE INDICATORS

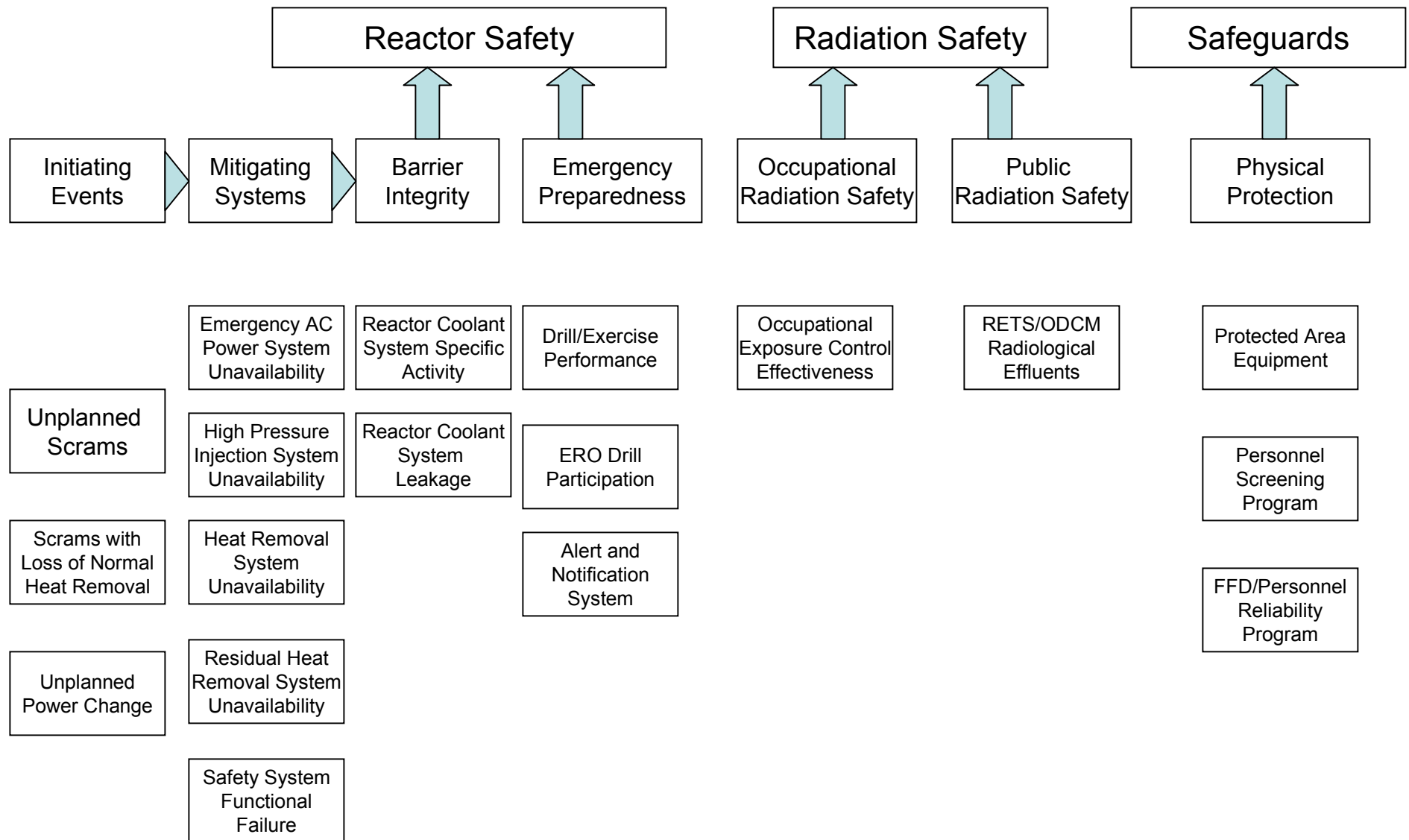
Cornerstone	Indicator	Thresholds (see Note 1)		
		Increased Regulatory Response Band	Required Regulatory Response Band	Unacceptable Performance Band
Initiating Events	Unplanned Scrams per 7000 Critical Hours (automatic and manual scrams during the previous four quarters)	>3.0	>6.0	>25.0
	Scrams with 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%
		>2EDG	>2.5%	>10.0%
		Hydro Emerg. Power	TBD	TBD
		BWRs		
		HPCI	>4.0%	>12.0%
		HPCS	>1.5%	>4.0%
		RCIC	>4.0%	>12.0%
		RHR	>1.5%	>5.0%
		PWRs		
		HPSI	>1.5%	>5.0%
		AFW	>2.0%	>6.0%
		RHR	>1.5%	>5.0%
	Safety System Functional Failures (over previous four quarters)	BWRs	>6.0	N/A
		PWRs	>5.0	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

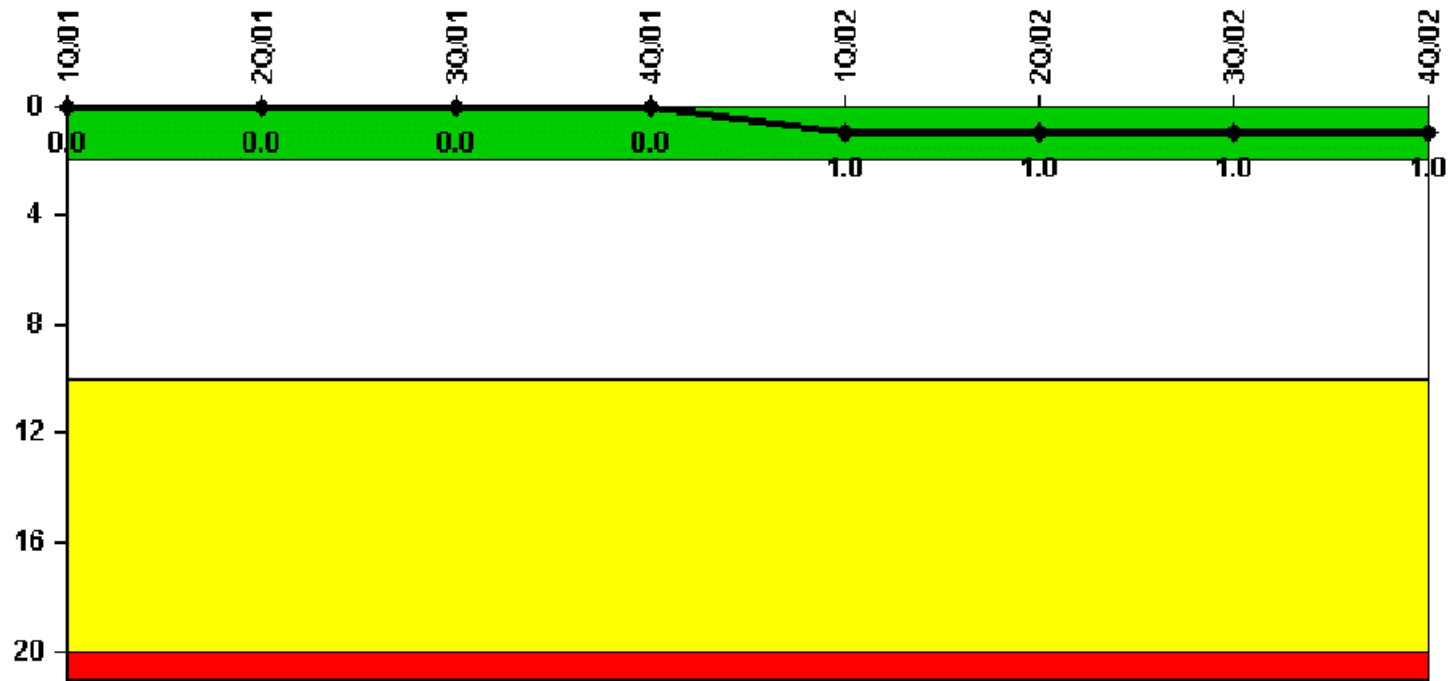
- The Green-White, White-Yellow, and Yellow-Red Thresholds Are Set to Coincide with $\Delta \text{CDF} > 1\text{E-}06$, $1\text{E-}05$, and $1\text{E-}04$, Respectively.
- The Significance of an Inspection Finding Is Assessed Using the Significance Determination Process (SDP).

Performance Indicators in the Seven Cornerstones



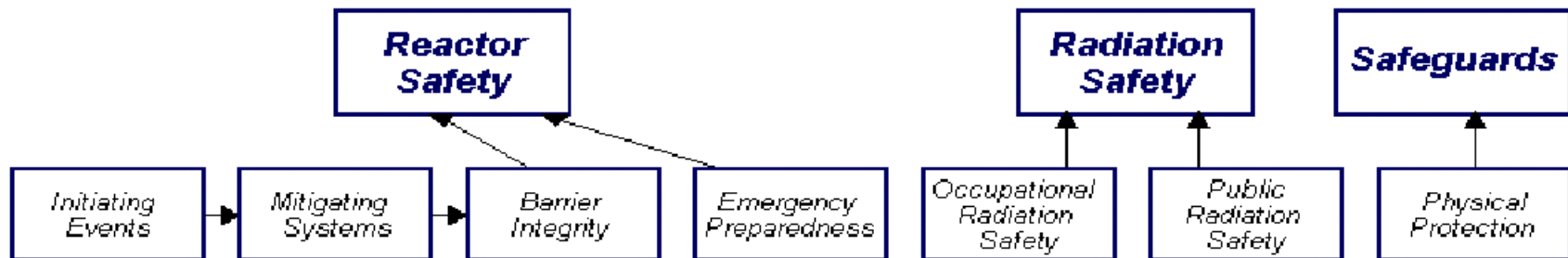
TYPICAL PERFORMANCE INDICATOR

Scrams with Loss of Normal Heat Removal



Thresholds: White > 2.0 Yellow > 10.0 Red > 20.0

4Q PERFORMANCE INDICATORS



Performance Indicators

Unplanned Sorams (G)	Emergency AC Power System Unavailability (G)	Reactor Coolant System Activity (G)	Drill/Exercise Performance (G)	Occupational Exposure Control Effectiveness (G)	RETS/ODCM Radiological Effluent (G)	Protected Area Equipment (G)
Sorams With Loss of Normal Heat Removal (G)	High Pressure Injection System Unavailability (G)	Reactor Coolant System Leakage (G)	ERD Drill Participation (G)			Personnel Screening Program (G)
Unplanned Power Changes (G)	Heat Removal System Unavailability (G)		Alert and Notification System (G)			FFD/Personnel Reliability Program (G)
	Residual Heat Removal System Unavailability (G)					
	Safety System Functional Failures (G)					

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

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

- **Unplanned Scrams with Loss of Normal Heat Removal**

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

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

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:
$$\frac{\text{\# of key ERO members that have participated in a drill, exercise or actual event during the previous 8 quarters}}{\text{Total number of key ERO members}} \times 100$$

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:

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

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

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