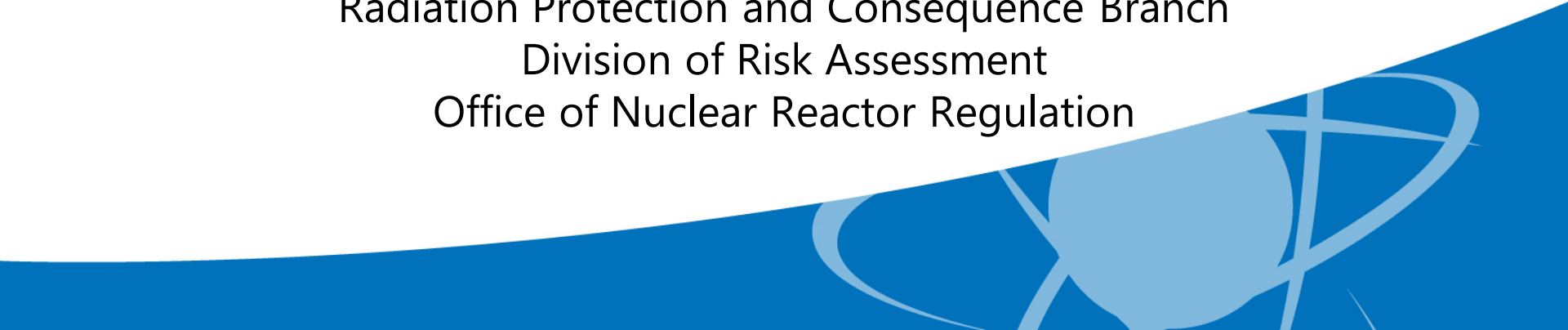


# **NRC Update on ALARA Activities, Regulatory Discussion**

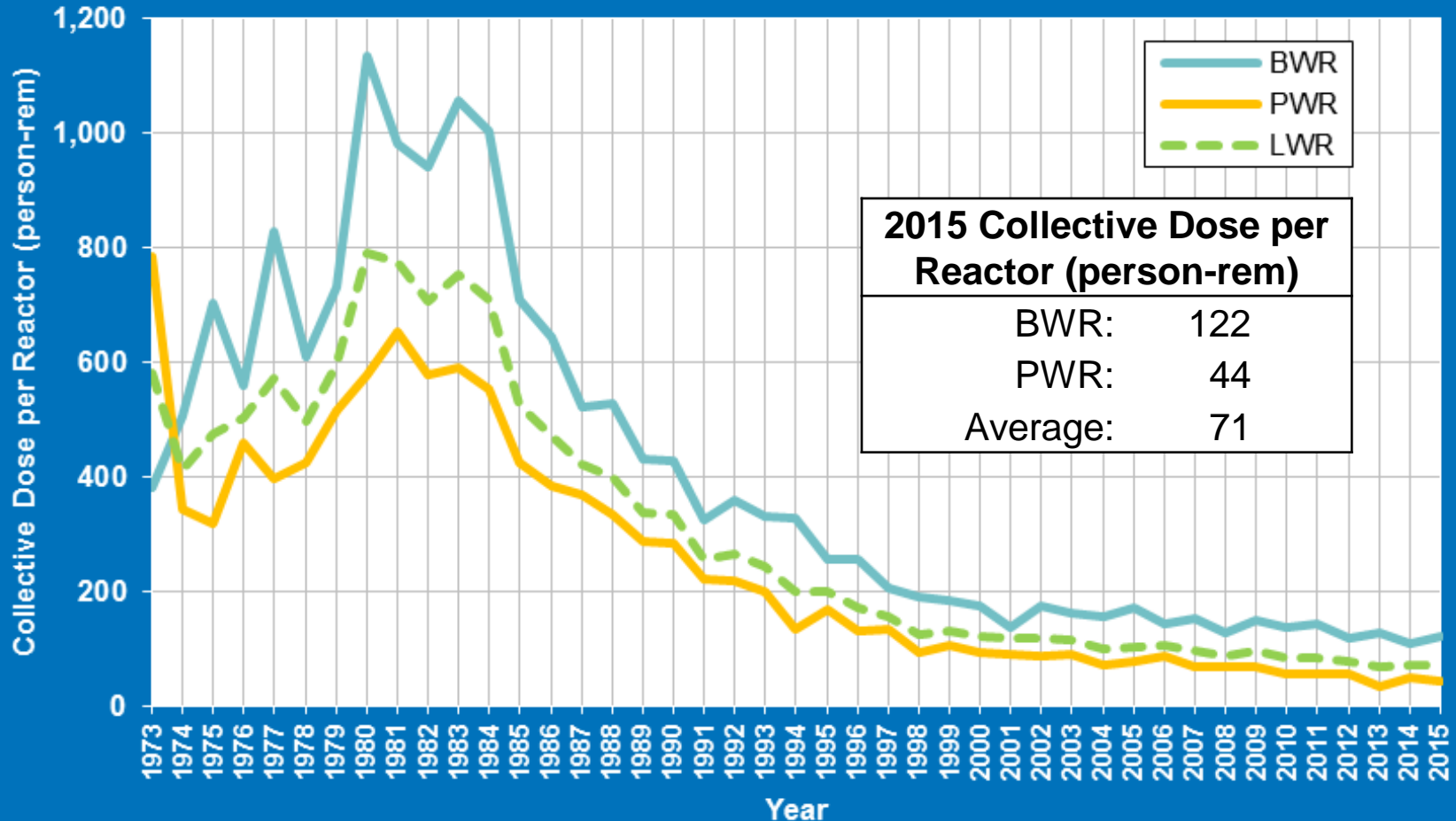
January 9-11, 2017

Steven Garry  
Sr. Health Physicist  
Radiation Protection and Consequence Branch  
Division of Risk Assessment  
Office of Nuclear Reactor Regulation



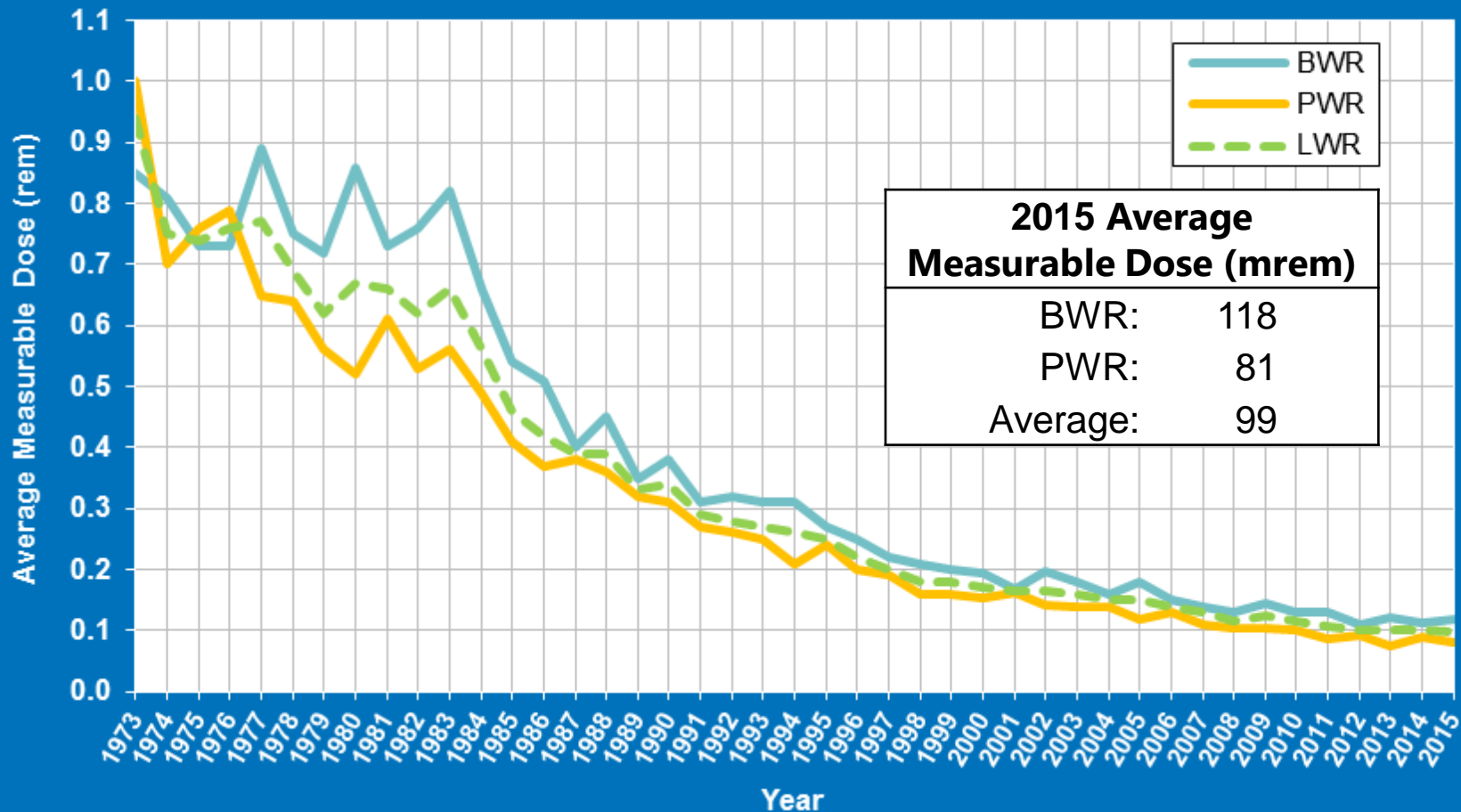
# U.S. Commercial LWR Collective Dose 1973 – 2015

### Average Annual Collective Dose



# Average Measurable Dose per Worker 1973 – 2015

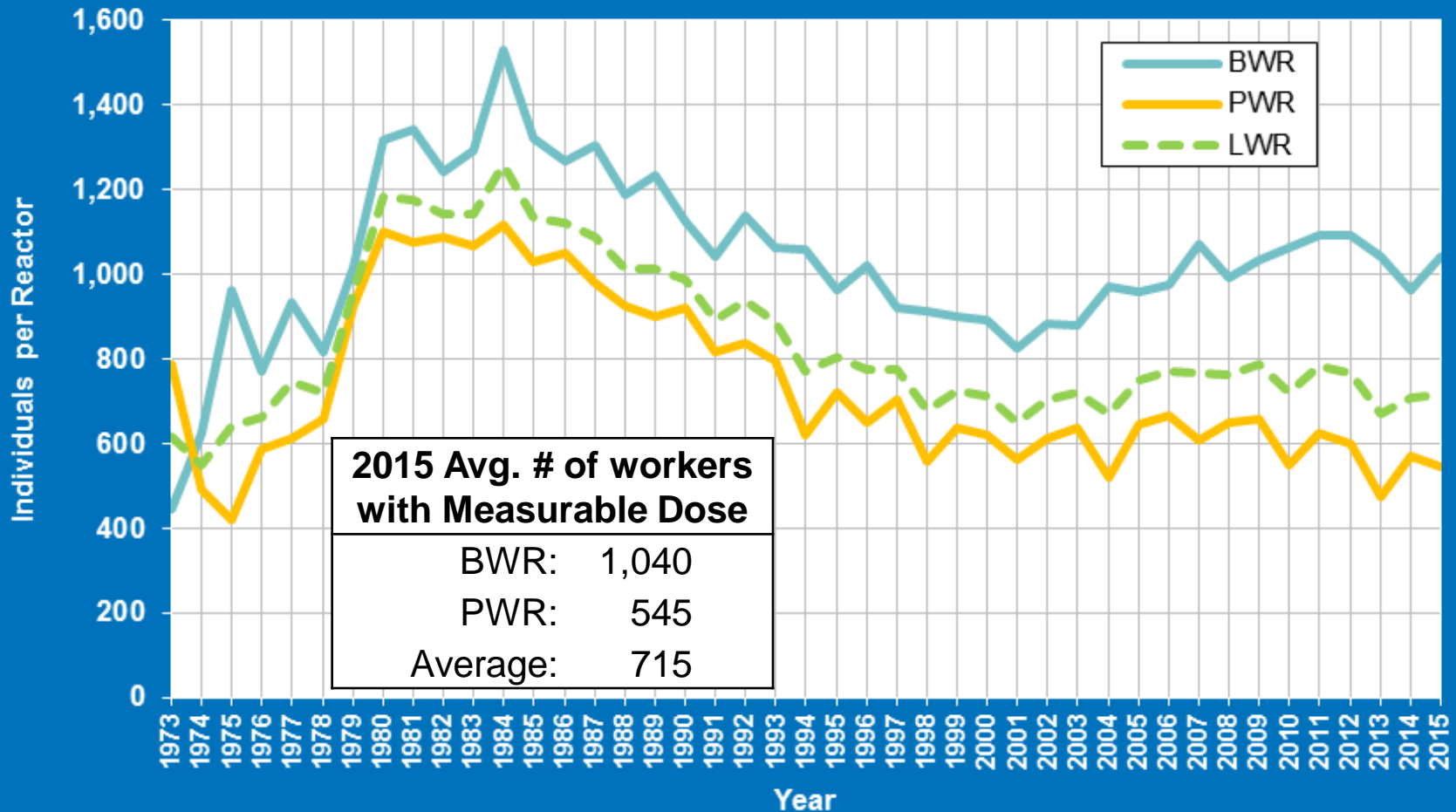
Average Measurable Dose per Individual\*



\* Not adjusted for transient workers.

# Average Number of Workers with Measurable Dose 1973 – 2015

Average Annual Number of Individuals with Measurable Dose



	Plant Name	Three Year Coll. TEDE per Reactor Year 2013-2015 (person-rem)	Percent Change From 2012-2014	2012-2014 Quartile (if changed)
1st Quartile	DUANE ARNOLD	52.947	-42% ▼	2
	FITZPATRICK	65.356	-43% ▼	3
	DRESDEN 2,3	65.457	0%	-
	OYSTER CREEK	66.059	-42% ▼	3
	LIMERICK 1,2	66.119	-8% ▼	-
	GRAND GULF	80.812	-51% ▼	4
2nd Quartile	CLINTON	81.427	52% ▲	1
	HATCH 1,2	82.877	-5% ▼	-
	QUAD CITIES 1,2	86.392	-4% ▼	-
	COOPER STATION	88.725	-49% ▼	4
	NINE MILE POINT 1,2	106.858	-28% ▼	3
	SUSQUEHANNA 1,2	109.026	5% ▲	-
3rd Quartile	RIVER BEND 1	110.987	40% ▲	1
	BROWNS FERRY 1,2,3	117.836	-14% ▼	-
	HOPE CREEK 1	118.991	5% ▲	-
	MONTICELLO	121.444	33% ▲	2
	PILGRIM	143.779	84% ▲	1
4th Quartile	FERMI 2	153.577	24% ▲	3
	BRUNSWICK 1,2	165.487	0%	-
	COLUMBIA GENERATING	182.257	80% ▲	2
	LASALLE 1,2	208.635	28% ▲	-
	PEACH BOTTOM 2,3	218.412	7% ▲	-
	PERRY	281.701	68% ▲	-
<b>Average per Reactor-Year</b>		<b>119.813</b>	<b>1% ▲</b>	

< Average 119.813

# Three-Year Collective TEDE per Reactor-Year for BWRs 2013-2015

White threshold > 240 rem

	Plant Name	Three-Year Coll. TEDE per Reactor Year 2013-2015 (person-rem)	Percent Change From 2012-2014	2012-2014 Quartile (if changed)
1st Quartile	BRAIDWOOD 1,2	21.135	-48% ▼	2
	PALO VERDE 1,2,3	23.523	-1% ▼	-
	FARLEY 1,2	24.476	22% ▲	-
	DIABLO CANYON 1,2	25.602	10% ▲	-
	CALLAWAY 1	27.808	-2% ▼	-
	CALVERT CLIFFS 1,2	28.128	-29% ▼	2
	GINNA	28.659	-26% ▼	2
	SOUTH TEXAS 1,2	29.718	24% ▲	-
	BYRON 1,2	30.236	-4% ▼	-
	COOK 1,2	31.233	-9% ▼	-
2nd Quartile	OCONEE 1,2,3	31.608	-18% ▼	-
	WATTS BAR 1	31.735	2% ▲	1
	BEAVER VALLEY 1,2	33.312	-13% ▼	-
	SALEM 1,2	33.812	-6% ▼	-
	COMANCHE PEAK 1,2	37.895	-9% ▼	-
	HARRIS	38.042	-16% ▼	3
	CATAWBA 1,2	38.560	1% ▲	-
	NORTH ANNA 1,2	39.593	-21% ▼	3
	POINT BEACH 1,2	39.690	-9% ▼	3
3rd Quartile	ARKANSAS 1,2	43.055	56% ▲	1
	SEQUOYAH 1,2	43.148	-37% ▼	4
	PRAIRIE ISLAND 1,2	43.882	-18% ▼	4
	TURKEY POINT 3,4	45.944	-37% ▼	4
	WATERFORD 3	46.139	-58% ▼	4
	SEABROOK	46.159	44% ▲	1
	INDIAN POINT 2,3	46.165	-15% ▼	4
	MILLSTONE 2,3	48.112	-3% ▼	-
	FORT CALHOUN	48.298	34% ▲	2
4th Quartile	VOGTLE 1,2	49.268	0%	3
	MCGUIRE 1,2	49.513	-4% ▼	3
	SURRY 1,2	51.333	5% ▲	3
	ROBINSON 2	55.211	-5% ▼	-
	SUMMER 1	60.333	-9% ▼	-
	ST. LUCIE 1,2	64.018	1% ▲	-
	DAVIS-BESSE	68.006	-17% ▼	-
	WOLF CREEK 1	71.187	46% ▲	3
	THREE MILE ISLAND 1	103.251	105% ▲	3
	PALISADES	244.193	-2% ▼	-
Average per Reactor-Year		43.540	-8% ▼	

← Average 43.540

# Three-Year Collective TEDE per Reactor-Year for PWRs 2013–2015

White threshold > 135 rem

# Individual Worker Dose

- Performance indicator (PI) program applies to an individual's unintended dose or unauthorized entry into locked high radiation area
- NEI 99-02, Rev. 6, Regulatory Assessment Performance Indicator Guideline
- Examples: dose or dose rate alarm
  - evaluated under the performance indicator program
  - more than 100 mrem unintended dose is PI occurrence
  - unauthorized entry into a locked high radiation area
  - NRC expects licensees to use corrective action program to the fix problems

# NRC Focus

- Focus is not on the industry “averages”
- Focus is not on any one “individual’s dose”
- ALARA focus is on the collective dose for “individual plants” and “individual jobs”
- Significance of finding is assessed as Minor, Green, White, Yellow, Red



# NRC Inspection of ALARA

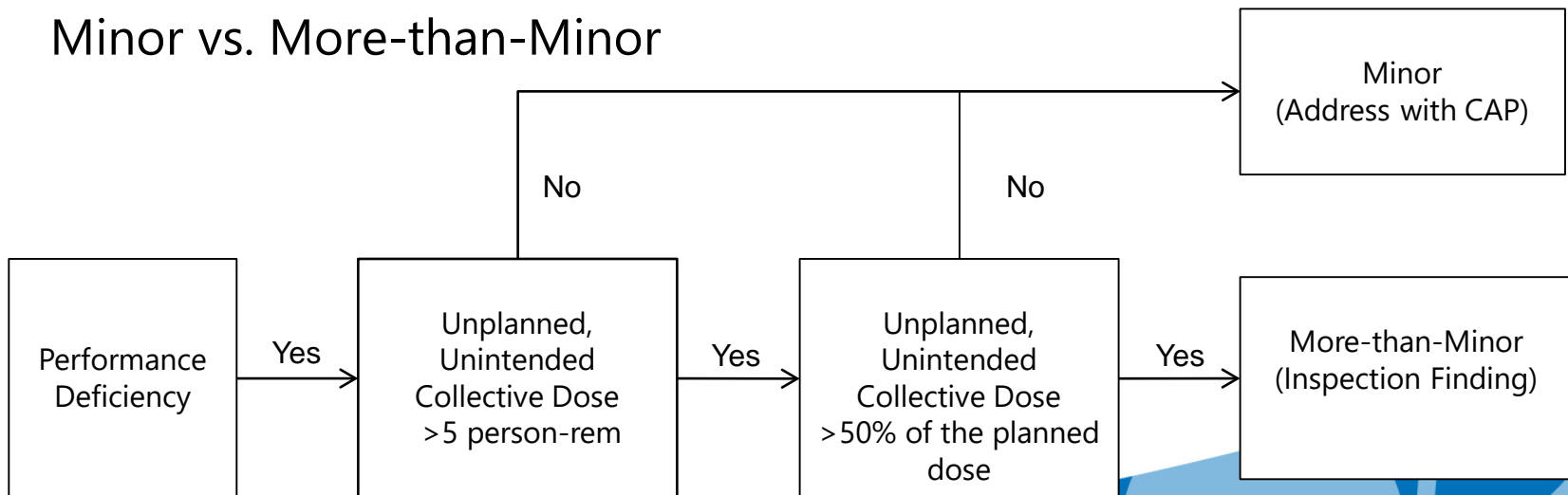
- ALARA planning is an inspectable area under the ROP: Inspection Procedure 71124.02 (Revised 2016)
  - radiological work planning
  - verification of dose estimates
  - implementation of ALARA work controls
  - radiation worker performance
  - corrective actions (Problem Identification and Resolution)
- Three-year averages
  - quartiles - used in planning inspection hours
  - collective dose - used in inspection findings

# Collective Dose

- ALARA compliance is based on collective dose
- Compliance is not based on whether individual doses are the absolute minimum, or use of all possible ALARA methods
- Green findings are based on exceeding 5 rem and 50% above estimates
- White findings are based on exceeding 25 rem

# ALARA Issue Screening

- **ALARA Findings:** performance deficiencies that concern *unplanned, unintended occupational collective dose*
- Performance Deficiency: Failure to meet a requirement or self-imposed standard where the cause was reasonably within the licensee's ability to foresee and correct
- Minor vs. More-than-Minor



# Significance Determination

- If three year average for:
  - PWR  $\leq$  135 rem PWR,
  - BWR  $\leq$  240 rem,
  - Significance is always “Green”
- If three year average is  $>$  135 rem PWR, or  $>$  240 rem BWR:
  - Is actual dose  $>$  25 rem AND  $>$  50% of the estimate?
    - No, then a Green finding
    - Yes, then a White finding, or
  - Were there more than 4 jobs where actual dose  $>$  5 rem and  $>$  50% above dose estimate?
    - No, then a Green finding
    - Yes, then a White finding

# NRC Findings

- NRC inspections every 2 years
- 5 findings in last 2 years at 65 sites

# Palisades

1<sup>st</sup> quarter, 2014 ML14127A543

- Control rod drive mechanism housing work
- Estimated dose was ~3 rem, actual dose was 26.5 rem, emergent work dose was 8.5 rem
- Problems:
  - Re-work of ultrasonic testing exams due to insufficient or inadequate initial exams,
  - Re-work of shielding - poor coordination of installation and removal re-work, and
  - Inadequate mock-up testing
- Green because 3 yr collective dose was < 135 rem (at the time of the inspection finding)

# Indian Point – Unit 2

3<sup>rd</sup> quarter, 2014 ML14314A052

- Reactor coolant pump work activities
  - estimate 7.3 rem, actual 13.7 rem
  - dose rates were 25 percent higher because crud burst was 6.7 uCi/cc (4 times higher than planned) and clean-up levels were not reduced to planned clean-up criteria
  - Some work was performed inside bioshield instead of on refueling floor which added 2.5 person-rem
  - failed to install temporary shielding prior to the start of work added ~1 rem; and
  - pump coupling rework and realignment added ~0.5 rem

# Fermi

4<sup>th</sup> quarter, 2014 ML15029A206

- Refuel activities including core alterations, bridge repair, local power range monitor replacement, fuel sipping
  - estimated 3.7 rem, actual 15.3 rem
  - estimated 9,070 hrs, actual 20,462 hrs
  - Problems:
    - increased radiation levels due to a crud burst
    - conflicts and delays with refueling equipment ,
    - procedural challenges,
    - equipment malfunctions
- Lack of observing & coaching
- In-progress review performed at 80% (too late)



# Millstone

4<sup>th</sup> quarter, 2014 ML15042A160

- Deficiencies in planning and work control while performing scaffolding work, valve maintenance, and a valve replacement
- Dose
  - Scaffolding – 11.8 rem estimate, 17.7 rem actual dose
  - valve maintenance – 5.5 rem estimate, 10.2 rem actual dose
  - valve replacement – 5.9 rem estimate, 11.6 rem actual dose
- Scaffold interferences between adjacent jobs
- Poor sequencing of work, work size control, inadequate exposure tracking, and poor pre-outage planning
- Disconnect - ALARA planners did not attend outage planning meetings

# Columbia

2<sup>nd</sup> quarter, 2015 ML15219A143

- Alternate Fuel Pool Cooling Modification
- Estimated 11.1 rem, actual 17.8 rem
- Unplanned, unintended dose > 50% of estimate
- Problems:
  - Delays in installing shielding & elevated dose rates
  - Lack of in-field welding expertise and supervisory oversight led to re-work
  - Not using low-dose waiting areas
  - In-progress reviews not done in timely manner



# Questions and Discussion