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Blind QC trend presentation

October 2024

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Changing the World's Energy Future

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Blind QC Trends

Battelle Energy Alliance manages INL for the
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Idaho National Laboratory

Value of Blind Performance Testing

- Assess the analytical performance on a regular basis
- Evaluate measurement capabilities
- Ensure quality assurance objectives are met
- Identify Trends
- Take action for improvement
- Meet DOELAP requirements

INL's Blind Performance Testing Program

- Double blind authentic urine and fecal samples are sent to the analytical laboratory quarterly. DOE-RESL site-specific performance evaluation program (SSPEP) spikes the samples per INL's requested parameters.
- Typical Schedule

Urine		
Quarterly		Annually
Am-241		Np-237
Pu-238, Pu-239/240		Th-228, Th-230, Th-232
H-3		U-233/234, U-238
Total U		Gamma(Co-60, Cs-137)
		Sr-90

Fecal		
Quarterly		Annually
Am-241		Sr-90
Pu-238, Pu-239/240		Np-237
		Th-228, Th-230, Th-232
		U-233/234, U-238
		Gamma(Co-60, Cs-137)

Performance Evaluation Acceptance Criteria

Blind Performance Evaluation Type	Individual Sample Acceptance Criteria
Accuracy and Agreement	Bias% = +/-30% and < 3 sigma (99% confidence interval)
Sensitivity	Agreement < 3
False Positive	Result - (3*CSU) < 0
False Negative	Result +/- (3*CSU) > 0

References for Criteria:

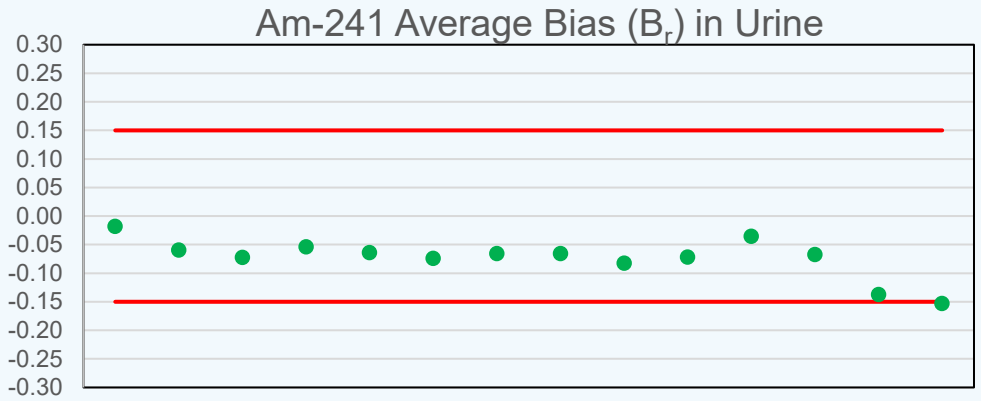
- ANSI N13.30-2011(R2017
- RESL-PLN-1
- MAPEP-HB-1
- Nelson rules of process control

Out of Control Signals for Trending Analysis

Blind Performance Evaluation Type	Trending Analysis Out of Control Signals	Signal Indicated
Accuracy	1. 3 sequential points outside +/- 15% average bias. 2. 9 sequential points on one side of the centerline without crossing. 3. 6 points in a row steadily increasing or decreasing.	1. A medium tendency for out of control conditions. 2. A prolonged bias exists. 3. A trend exists.
Agreement (for accuracy evaluations only)	3 sequential points above 2 sigma.	A medium tendency for out of control conditions.
Precision (for accuracy evaluations only)	3 sequential results > 0.40.	A medium tendency for out of control conditions.

Americium-241 in Urine Bias Trends

- Average Bias has 9 sequential points on the negative side of the centerline without crossing



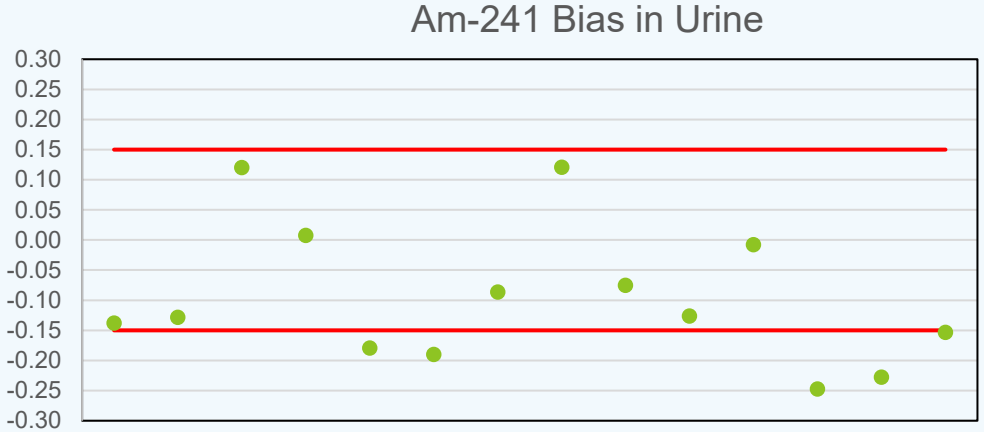
$$B_r = \sum_{i=1}^{n} \frac{B_{ri}}{n}$$

Where:

B_{ri} = individual relative bias

n = the number of measurements (sample size is at least five)

- Individual Bias results



$$Bias = \frac{C_m}{C_t} - 1$$

Where:

C_m = the measured activity of the control

C_t = the true (known) activity of the control.

Am-241 in Urine Agreement Trend

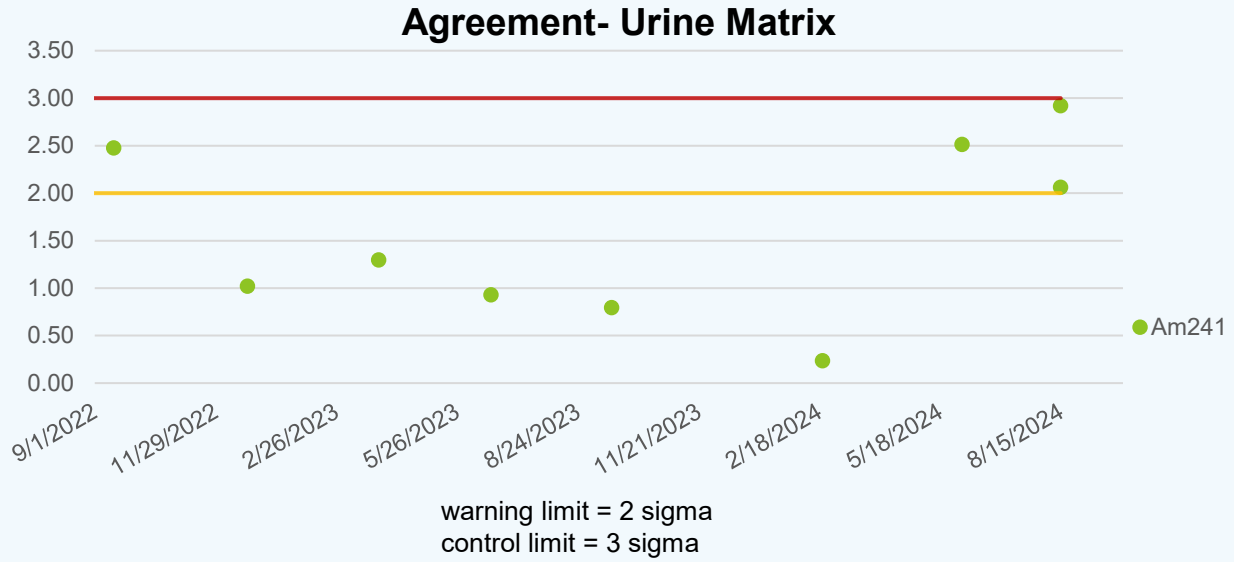
Agreement

$$|A| = \frac{(C_m - R_r) - 1}{CSU_r}$$

Where:

$\|A\|$ =	agreement (absolute value)
C_m =	measured activity of the control
R_r =	reference value ratio of measured activity and known activity
CSU_r=	CSU of ratio

- < 3 sigma=99% confidence interval; <2 sigma=95% confidence interval
- Out of control signal: 3 sequential points above 2 sigma agreement

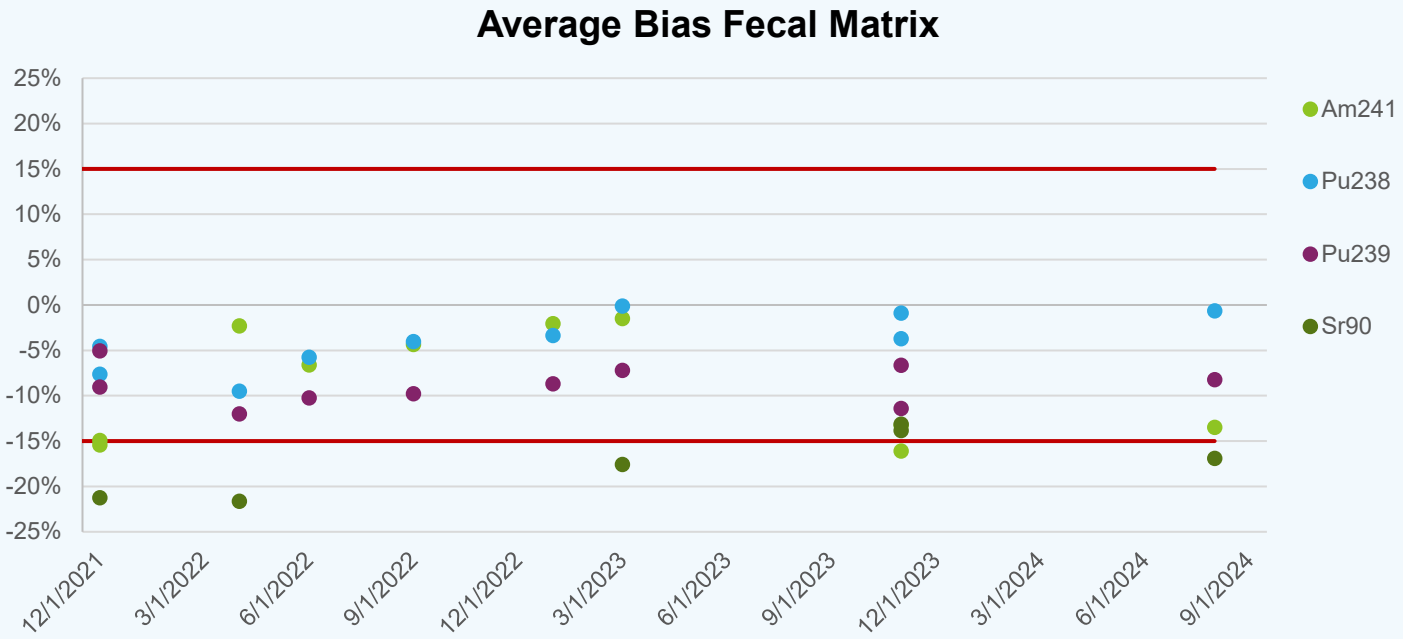


Possible Causes?

- Non-homogeneous matrix
- Age of samples

Am-241, Pu-238, Pu-239/240, and Sr-90 in fecal matrix

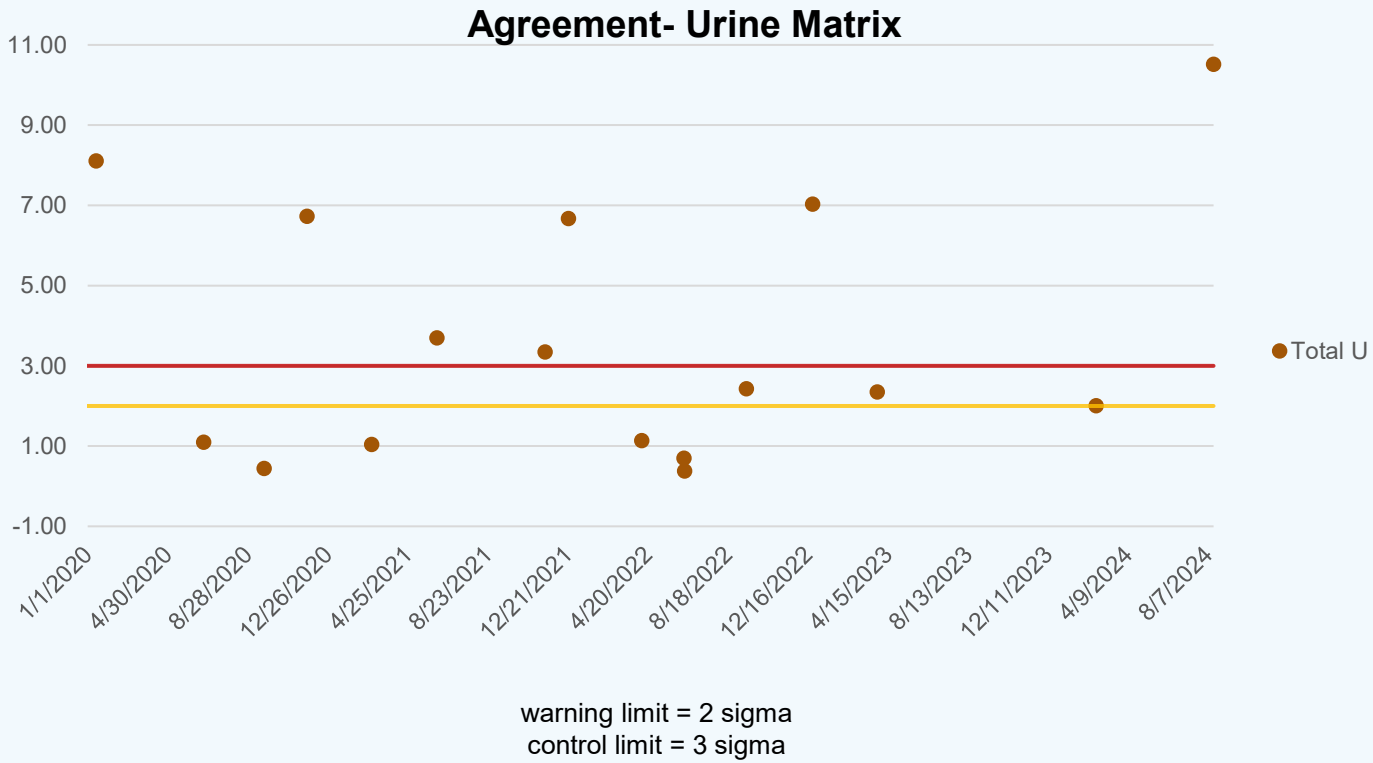
- Am-241, Pu-238, Pu-239/240, and Sr-90 in fecal matrix have 9 sequential points on the negative side of the centerline without crossing.



Possible Causes?
This trend is theorized to be due to incomplete dissolution of solids which could be related to the age of the spiked samples. Our stock of blind PE fecal samples has been in the freezer for over 3 years. Remaining stock of blind PE fecal samples have been analyzed, so future blind samples will be freshly spiked to eliminate the age of the samples as a contributing factor to out-of-control signals.

Total Uranium in Urine Agreement

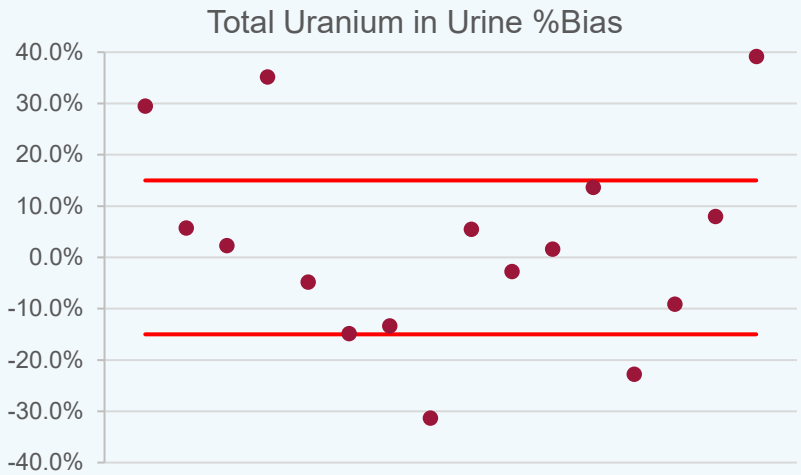
- Total Uranium has 3 sequential points above 2 sigma agreement.



warning limit = 2 sigma
control limit = 3 sigma

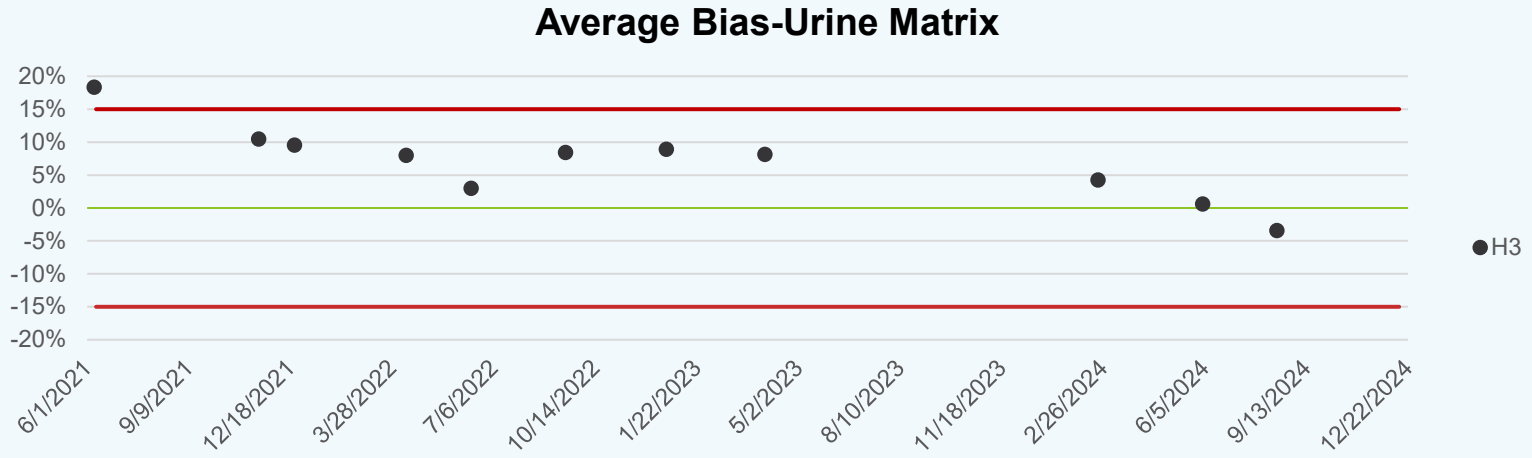
Possible Causes?

- Bias Fluctuation
- Spike Levels>20*RDL
- Age of samples



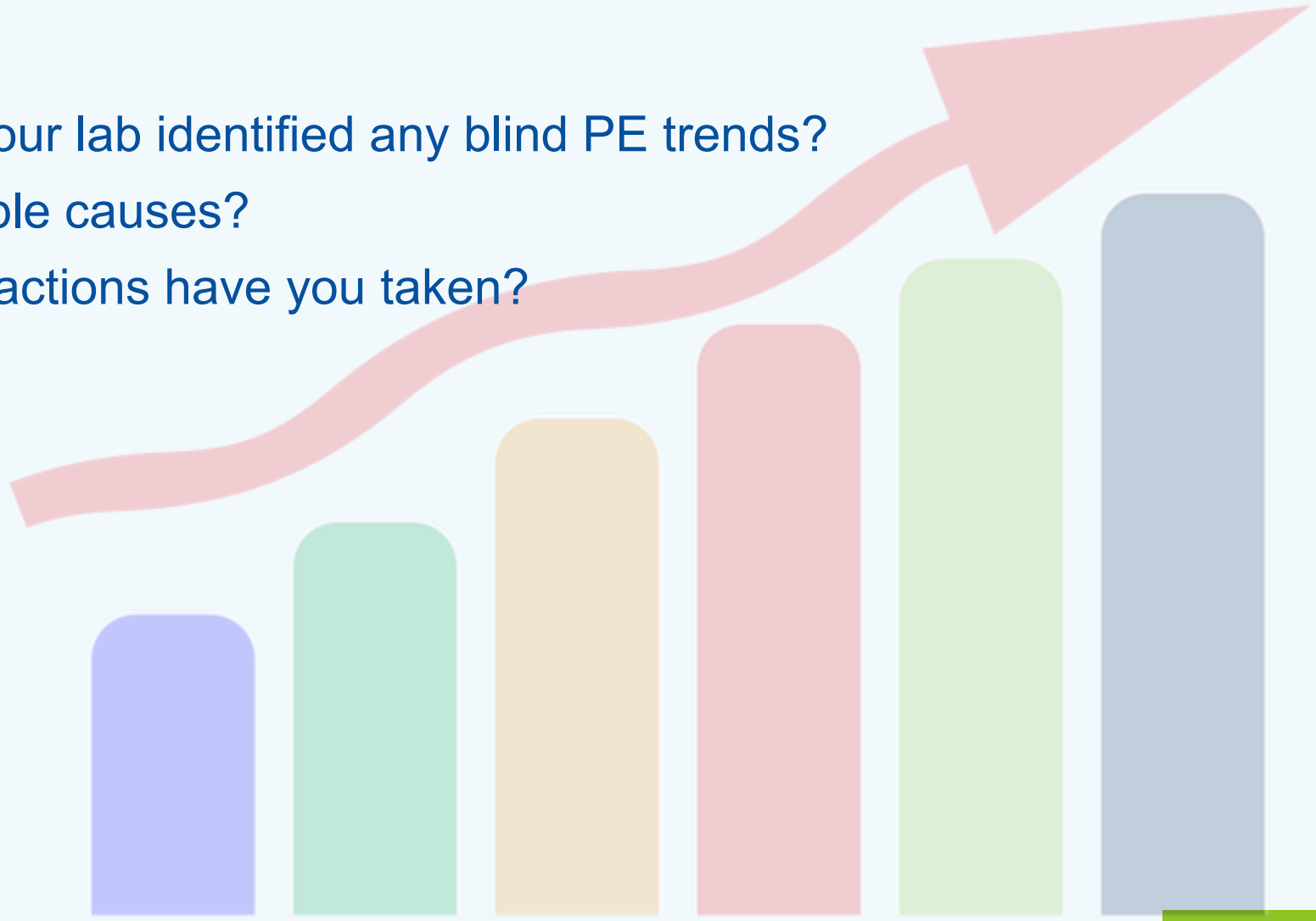
Other Trends

- Cs-137 in urine has exhibited positive bias trends. Recent blind testing included false positive and sensitivity evaluations that all passed acceptance criteria.
- Co-60 in urine has exhibited positive bias trends. Recent blind testing included false positive, false negative, and sensitivity evaluations. One false negative test out of the last two failed acceptance criteria. However, the result was greater than our critical level. If it were a worker's sample, follow-up recounts would have been requested.
- H-3 in urine showed a positive trend of 9 sequential results above 0% bias until the most recent results.



Discussion

- Has your lab identified any blind PE trends?
- Possible causes?
- What actions have you taken?



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