# Intelligent Method for Retesting a Wafer

Pai Chang / YK Huang
Teslence Technology Co., Ltd

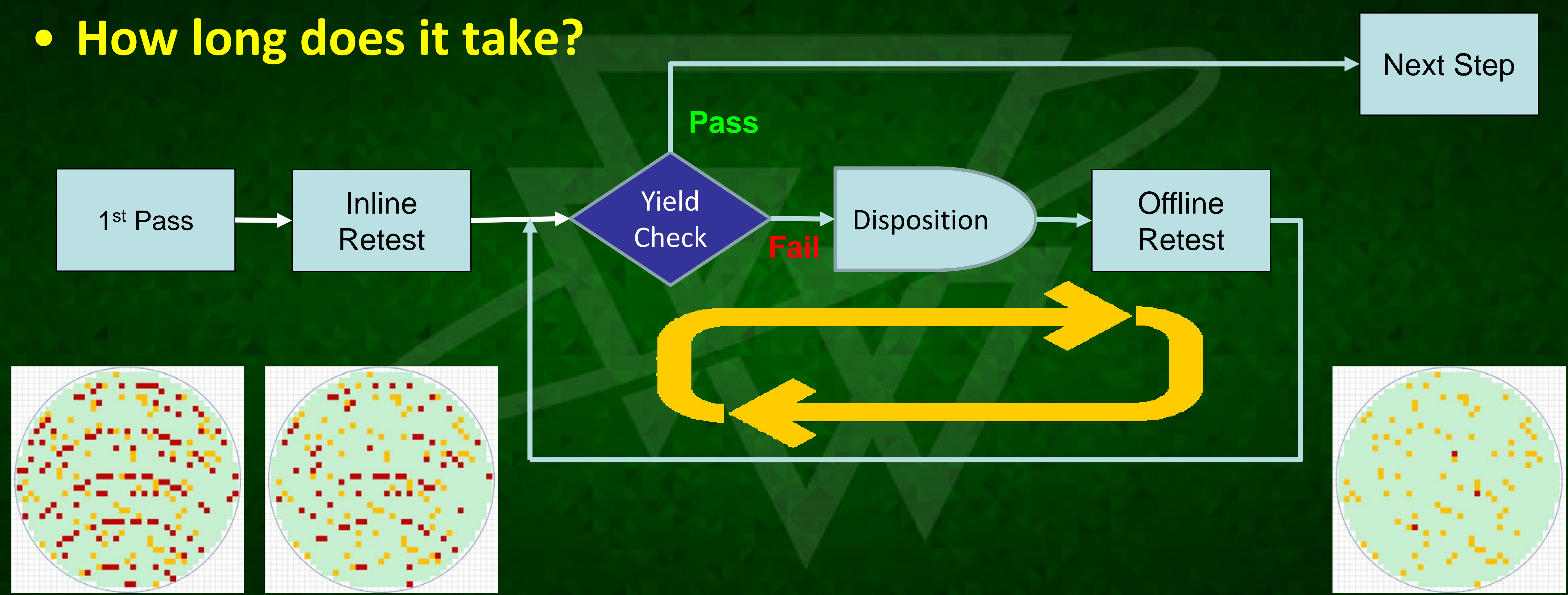
June 2-5,2019

# Overview

- Probe Production Issues
- Concept of an intelligent retest
- Methodology
- Result analysis
- Other capability
- Summary

# Probe Production Flow

- **How long does it take?**



# What happened?

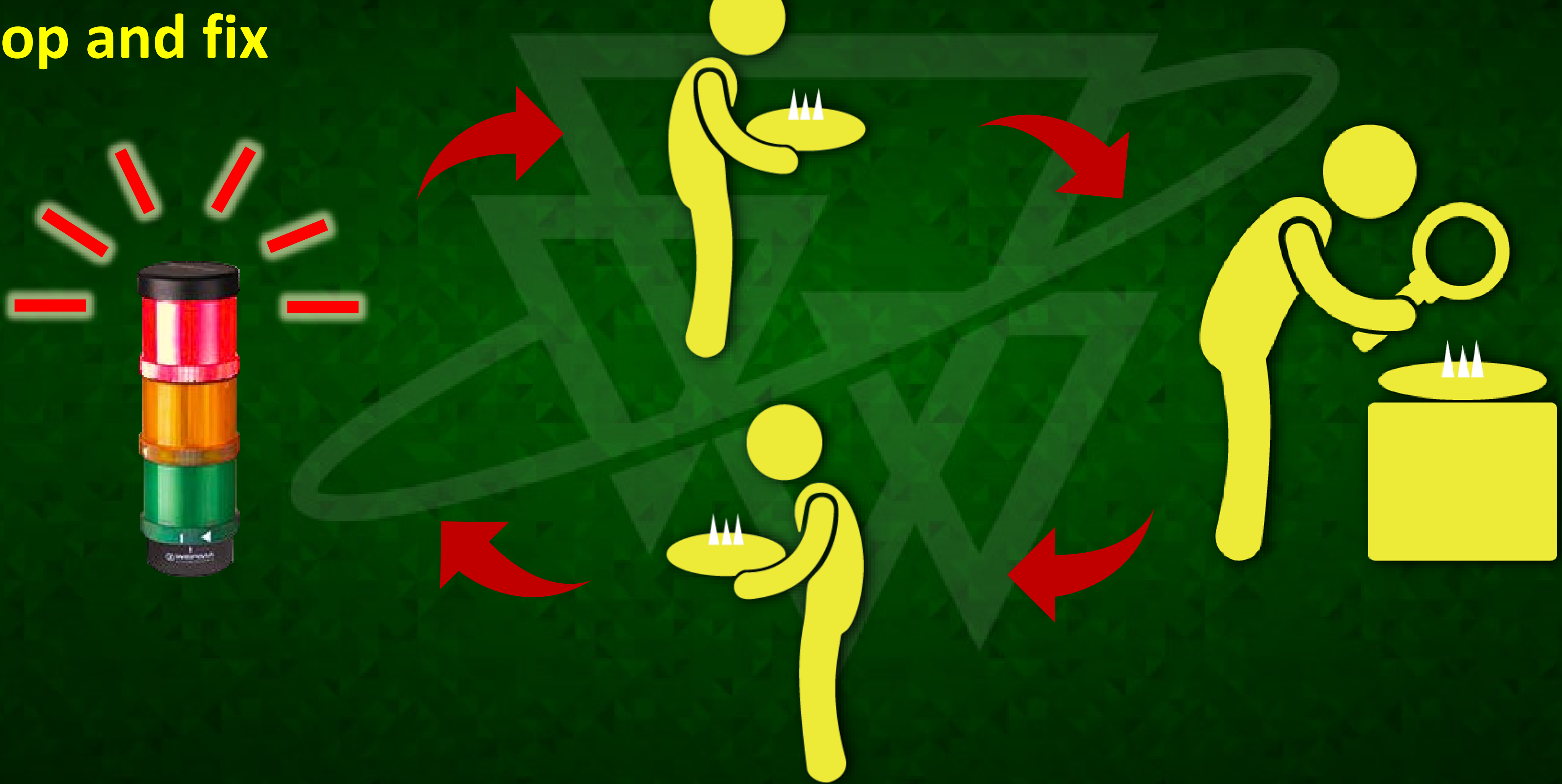
- Low site to site yield from first pass to inline retest

| Site | FirstPass | Inline Retest |
|---|---|---|
| All | 82.63% | 87.60% |
| 0 | 91.93% | 91.93% |
| 1 | 92.45% | 92.45% |
| 2 | 37.25% | 62.75% |
| 3 | 96.03% | 96.03% |
| 4 | 89.66% | 89.66% |
| 5 | 72.41% | 85.52% |
| 6 | 92.19% | 92.19% |
| 7 | 91.34% | 91.34% |

- Probe head?
- Tester?
- Prober?
- Program?
- Probe Card?
- PIB?
- Docking?
- Alignment?

# Now What?

- **Stop and fix**

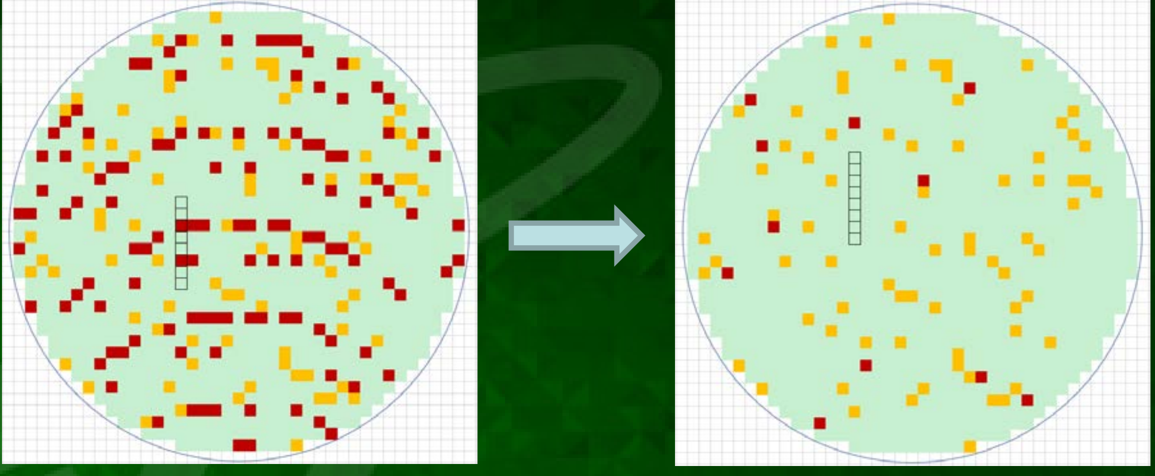


# Or another way…

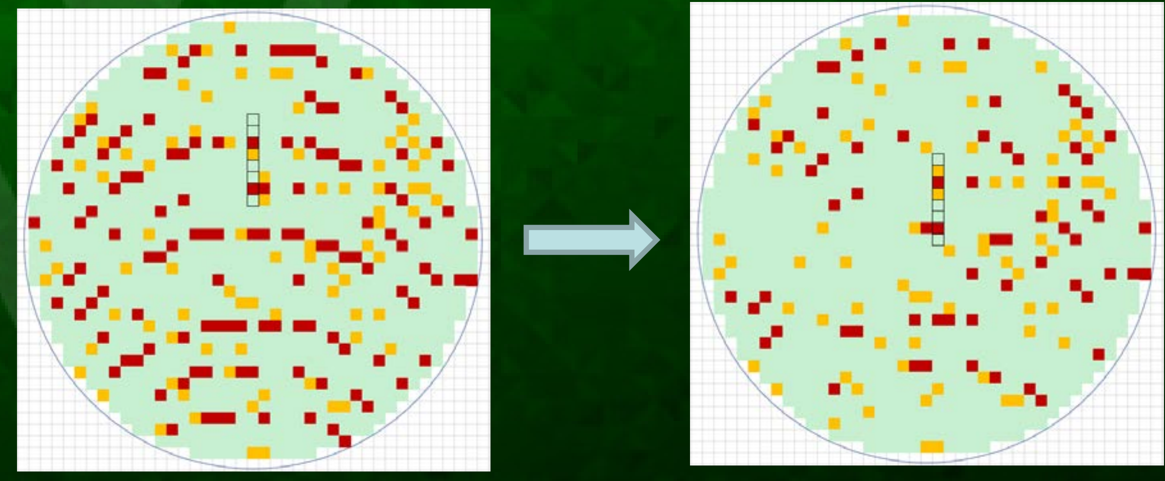
- **Blind shift site reprobe on prober**
  - Pre-defined 2$^{nd}$ step map
  - Fixed shift site location

- **Cons:**
  - Need to setup for each device
  - Wafer stepping optimization lost
  - Performance may differ base on low yield site locations

Non-overlapping: Low Yield S2 & S5, retested with S6 & S0

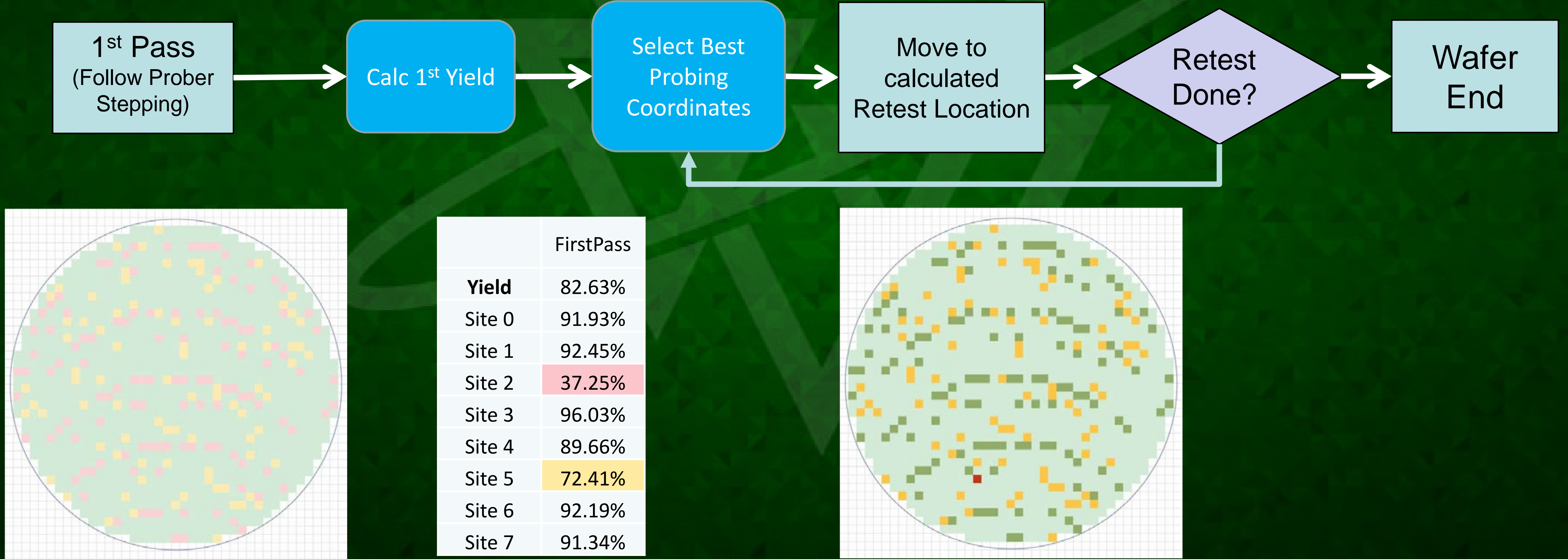


Overlapping: Low Yield S2 & S6, retested with S6 & S2



# Intelligent Reprobe

- We called **xREPROBE**, use best yielding sites
- Patented : TW I639846 ; Pending in US and others




| | FirstPass |
|---|---|
| **Yield** | 82.63% |
| Site 0 | 91.93% |
| Site 1 | 92.45% |
| Site 2 | 37.25% |
| Site 3 | 96.03% |
| Site 4 | 89.66% |
| Site 5 | 72.41% |
| Site 6 | 92.19% |
| Site 7 | 91.34% |

# Methodology

## 1$^{st}$ step: Optimize for retest time

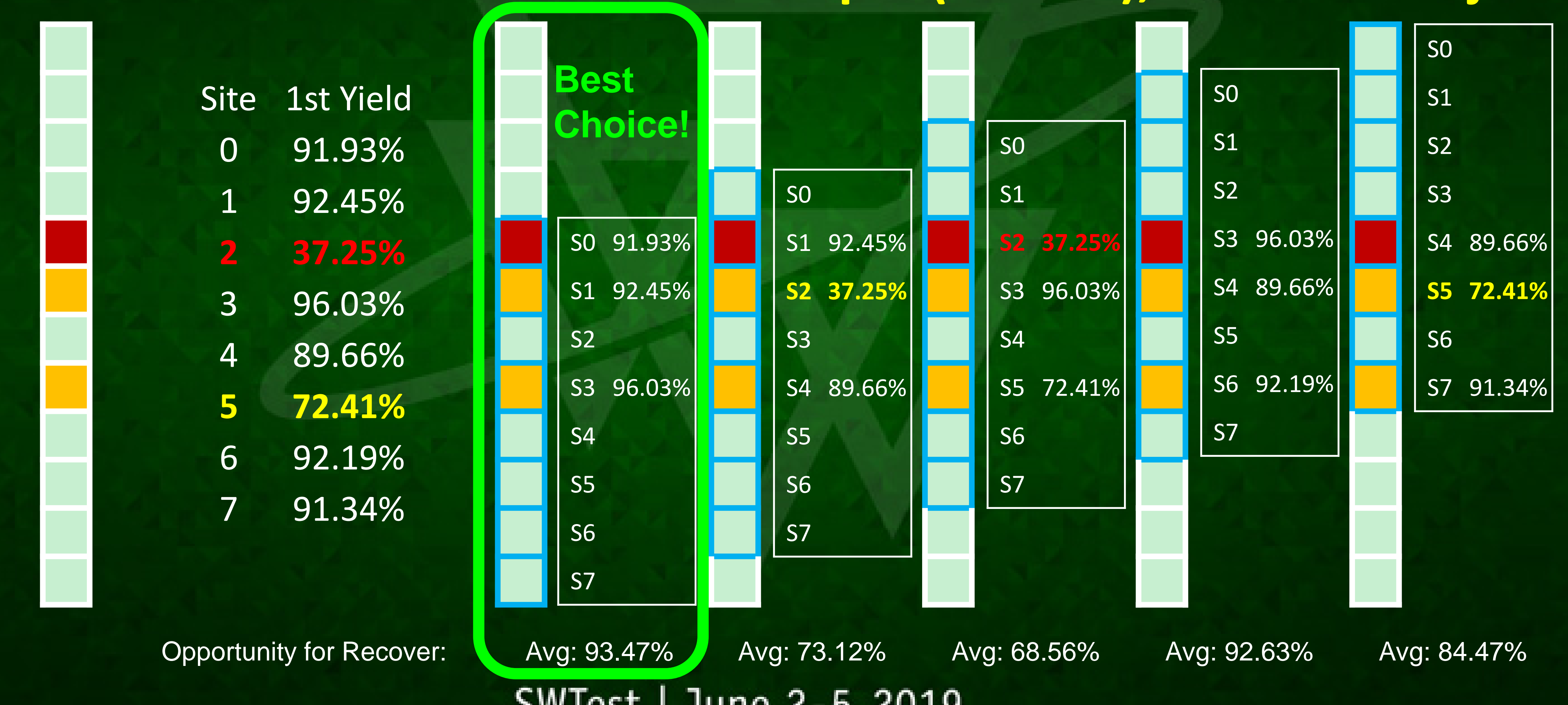
- Find location to test as many as rejects as possible
- Among the possible shifts, pick the best sites to retest

## 2$^{nd}$ step: Optimize for retest yield

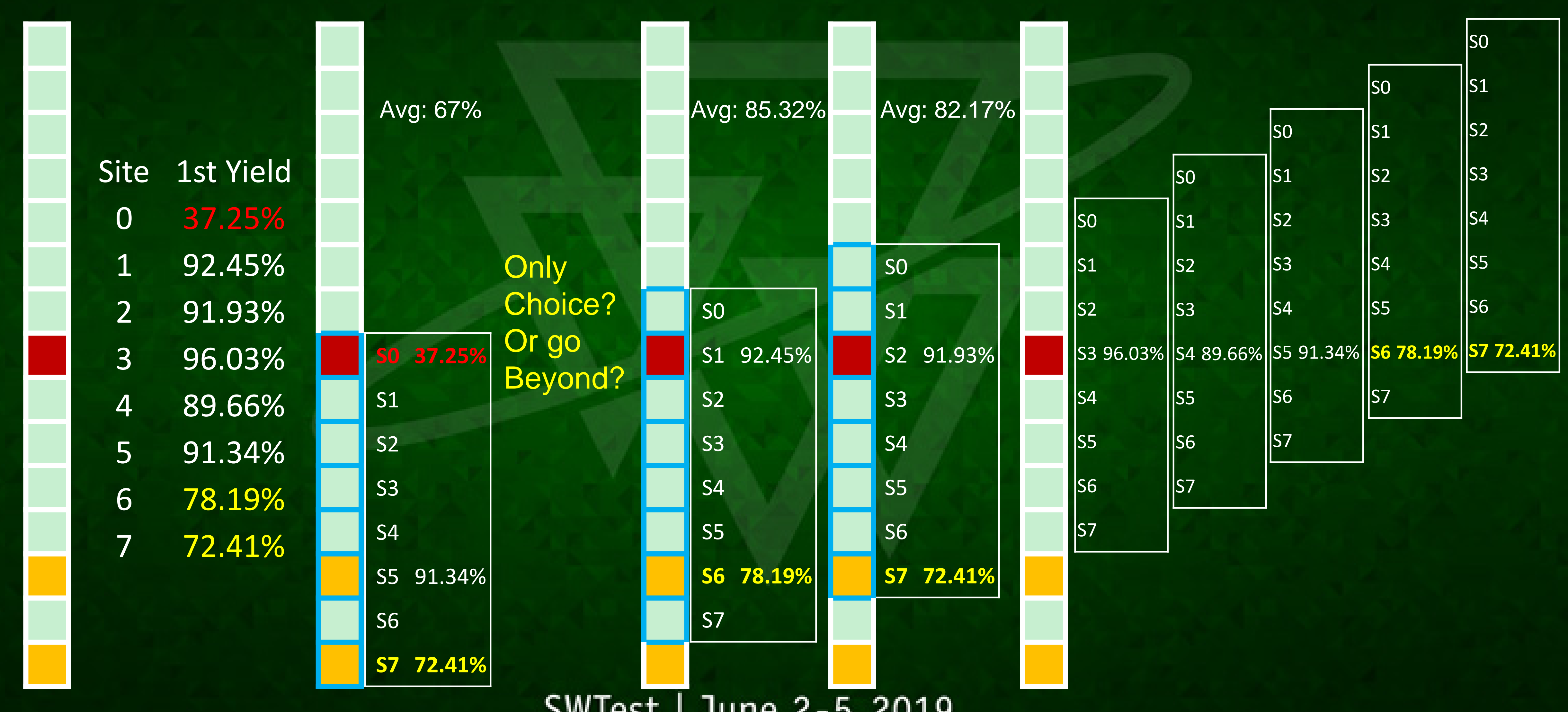
- If chances to recover are low, look for other shift testing fewer rejects
- Rules include:
  - Possible recovery yield control
  - Retested with bad site

# How Do We Decide? - Optimize Retest Time

- Options we have for retest on example (1x8 PH), to test all rejects



# How Do We Decide? - Optimize Retest Yield

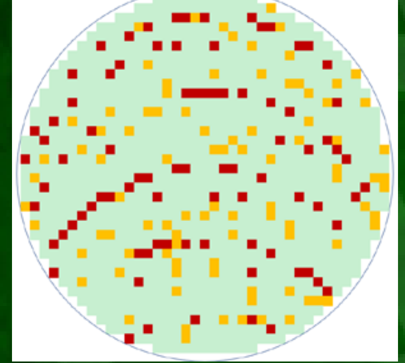


# Result Comparison –
# Low Yield on none overlap sites

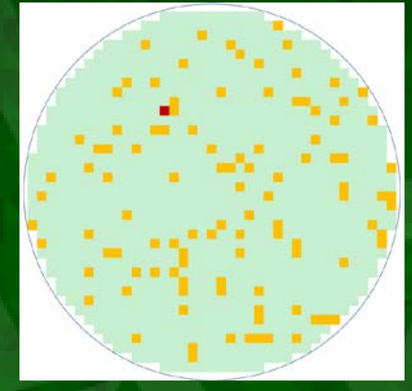
Retest Options

First Pass

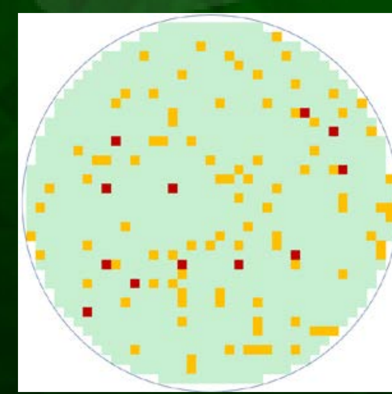
Traditional



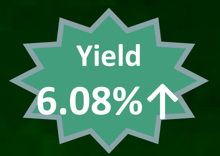
xREPROBE



Blind Shift



xREPROBE vs Traditional:



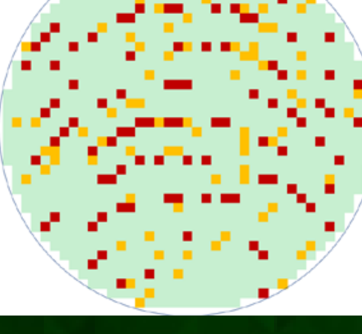

| | FirstPass | Retest Options | | |
|---|---|---|---|---|
| | | Traditional | Blind Shift | xREPROBE |
| Yield | 78.36% | 84.77% | 90.93% | 90.85% |
| 0 | 92.55% | 12 ① | 16 | 59 |
| 1 | 93.08% | 11 | 62 | 80 |
| 2 | 26.80% | 112 | 12 | 0 |
| 3 | 92.05% | 12 | 16 | 47 |
| 4 | 88.97% | 16 | 12 | 19 |
| 5 | 57.24% | 62 | 11 | 3 |
| 6 | 90.63% | 12 | 112 | 29 |
| 7 | 87.40% | 16 | 12 | 16 |
| TD | 161 | 141② | 160 | 128 |
| RedCnt | 147 | 85 | 12 | 1 |
| RedPct | 12.57% | 7.27% | 1.03% | 0.09% |

①: Number represents number of rejects tested
②: Number represents number of touch downs

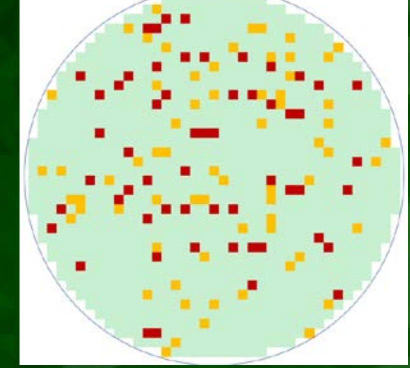
# Result Comparison – Low Yield on overlap sites

Retest Options

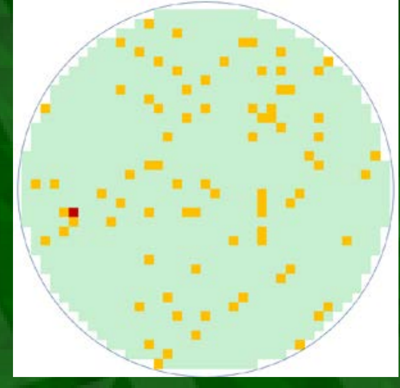
First Pass



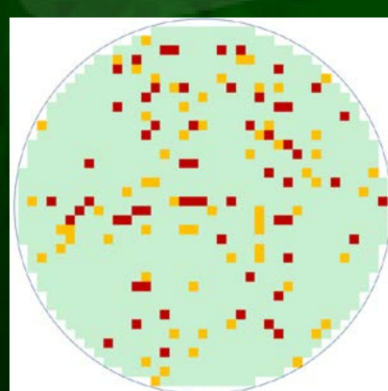
Traditional

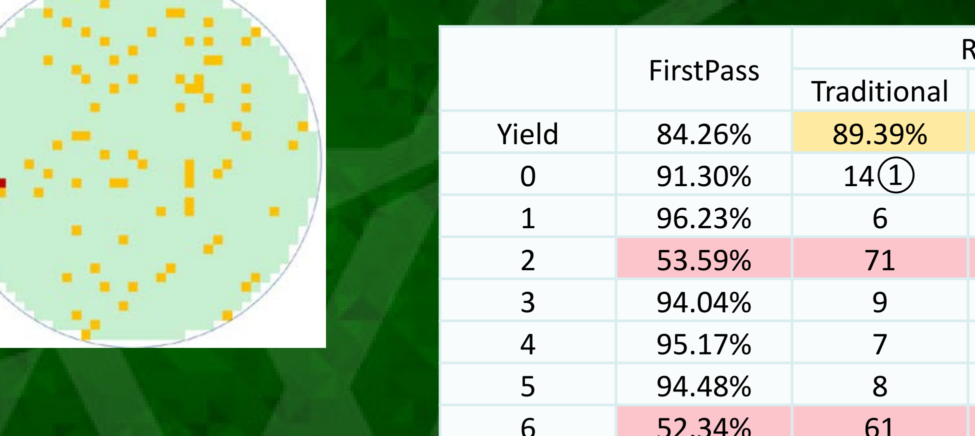


xREPROBE



Blind Shift





xREPROBE vs Traditional:

Yield 3.6%↑

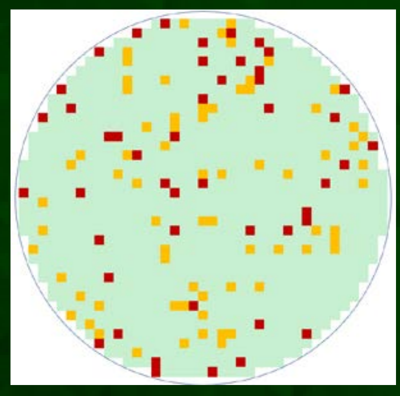
| | FirstPass | Retest Options | | |
|---|---|---|---|---|
| | | Traditional | Blind Shift | xREPROBE |
| Yield | 84.26% | 89.39% | 89.39% | 92.99% |
| 0 | 91.30% | 14① | 7 | 14 |
| 1 | 96.23% | 6 | 8 | 83 |
| 2 | 53.59% | 71 | 61 | 3 |
| 3 | 94.04% | 9 | 8 | 11 |
| 4 | 95.17% | 7 | 14 | 12 |
| 5 | 94.48% | 8 | 6 | 38 |
| 6 | 52.34% | 61 | 71 | 2 |
| 7 | 93.70% | 8 | 9 | 21 |
| TD | 161 | 112② | 121 | 99 |
| RedCnt | 102 | 57 | 59 | 1 |
| RedPct | 8.73% | 4.88% | 5.05% | 0.09% |

①: Number represents number of rejects tested
②: Number represents number of touch downs

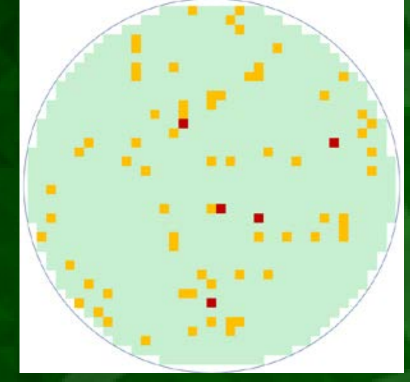
# Result Comparison – Normal Yield Across Sites

Retest Options

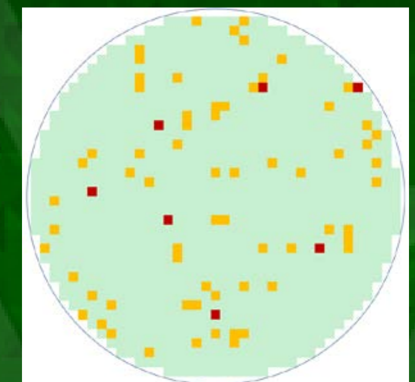
First Pass



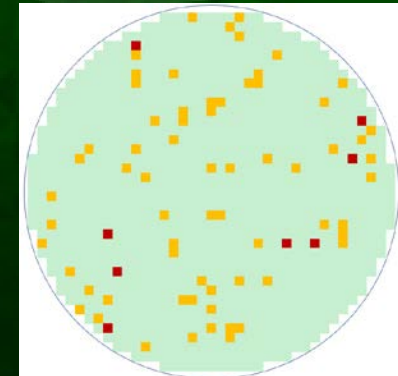
Traditional



xREPROBE



Blind Shift



| | FirstPass | Retest Options | | |
|---|---|---|---|---|
| | | Traditional | Blind Shift | xREPROBE |
| Yield | 89.91% | 93.76% | 93.67% | 93.76% |
| 0 | 88.20% | 19 | 18 | 3 |
| 1 | 86.16% | 22 | 15 | 4 |
| 2 | 89.54% | 16 | 14 | 10 |
| 3 | 95.36% | 7 | 7 | 56 |
| 4 | 87.59% | 18 | 19 | 2 |
| 5 | 89.66% | 15 | 22 | 8 |
| 6 | 89.06% | 14 | 16 | 12 |
| 7 | 94.49% | 7 | 7 | 23 |
| TD | 161 | 78 | 87 | 69 |
| RedCnt | 47 | 5 | 8 | 7 |
| RedPct | 4.02% | 0.43% | 0.68% | 0.60% |

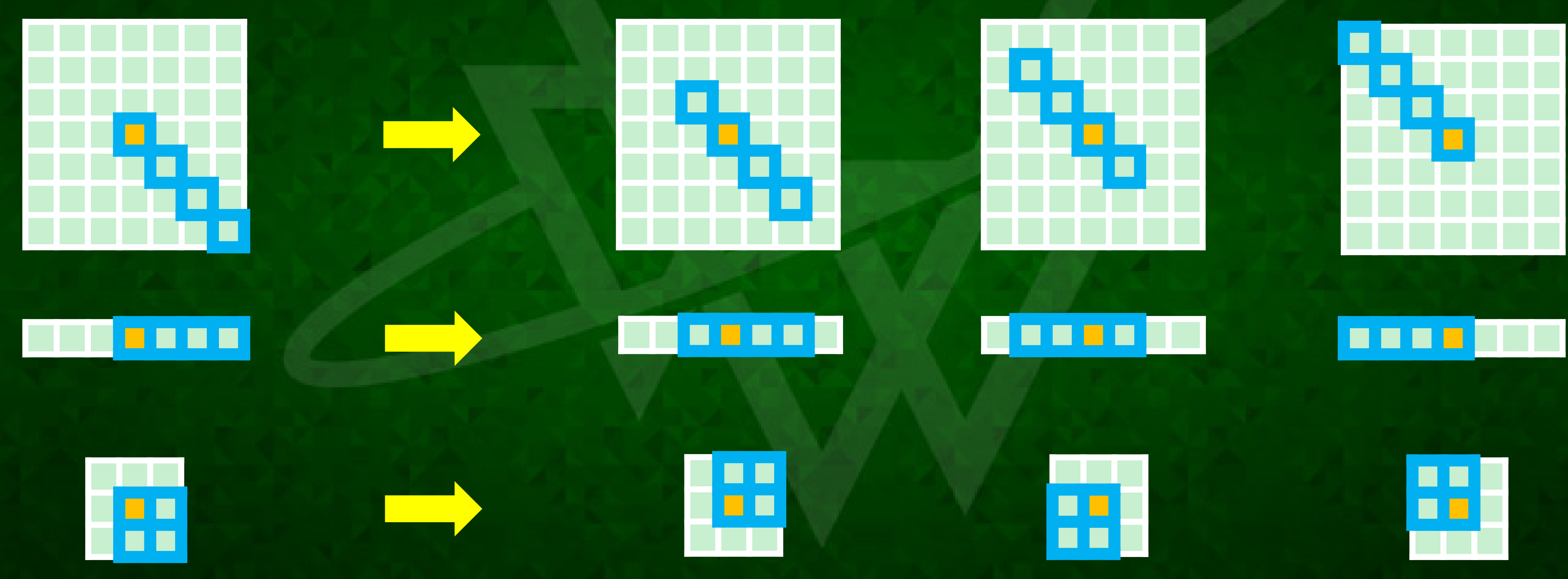
①: Number represents number of rejects tested
②: Number represents number of touch downs

# Result Comparison

| Retest Method | Traditional | Blind Shift Site | xREPROBE |
|---|---|---|---|
| Retest Yield | • Uses same site to retest<br>• Worst recovery on site to site issue | • Recovery rate is hard to predict depending on low yield site location<br>• Resulting in continued false fails from low yielding sites | • Best recovery yield with accurate binning |
| Retest Time | • Standard retest TD | • Increase of TD because change site away from optimized stepping<br>• Retest time increased due to increase of TD | • Optimized and use fewest TD to retest<br>• Calculated for each wafer so every retest is optimized |

# Different Layout

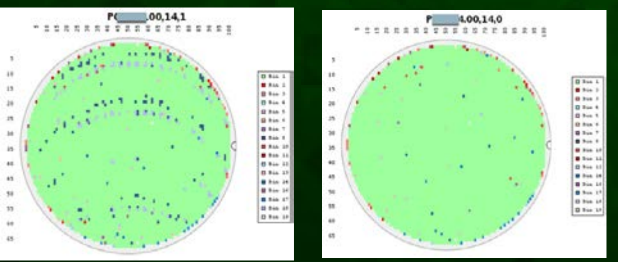
- Look for shift site locations based on different layouts

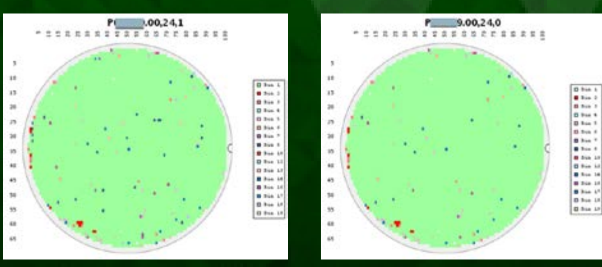


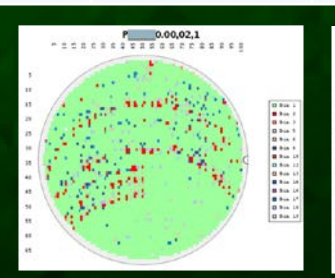
# Result on 16 sites

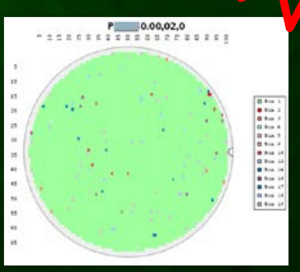
- **Ran 3 wafers to review results**
- **Saved 2% on test time and wafer show no sign of site to site fail pattern after retest**

| Wafers | First Yld | Final Yld | Total TD | Traditional Rsc TD | xREPROBE Rsc TD | Rsc % Save | Traditional Total TD | xREPROBE Total TD | Save % |
|---|---|---|---|---|---|---|---|---|---|
| AXXXX4_14 | 93.97% | 98.04% | 396 | 206 | **192** | **6.80%** | 602 | **588** | **2.33%** |
| AXXXX9_24 | 97.83% | 98.28% | 396 | 61 | **53** | **13.11%** | 457 | **449** | **1.75%** |
| AXXXX0_02 | 89.75% | 98.11% | 396 | 226 | **214** | **5.31%** | 622 | **610** | **1.97%** |
| Average | 93.85% | 98.14% | 396 | 164.33 | **153** | **6.89%** | 560.33 | **549** | **2.02%** |









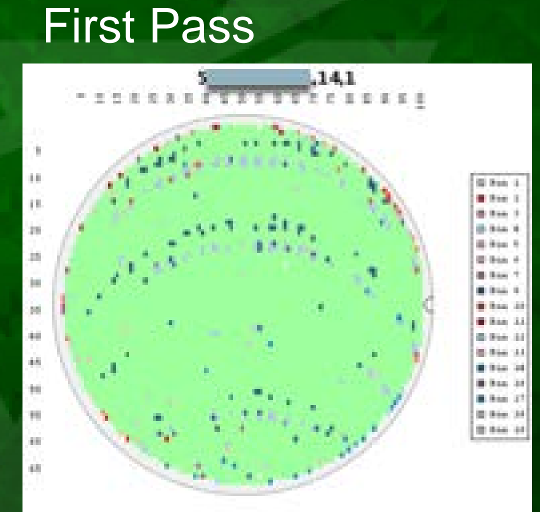
# Effectiveness on 16 sites

- **No Bad Die retested on low yield site 9 and 11**
- **Wafer clean and good to release with no downtime!**

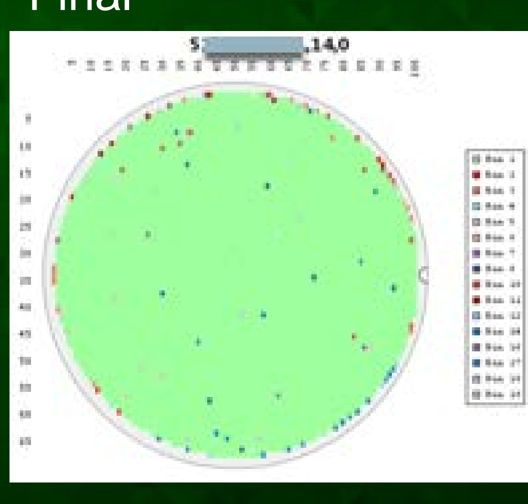
| First Pass Yield | | |
|---|---|---|
| Serial.Site Number | Bin Pass Yield | Bin Total |
| 0 | 94.04 | 369 |
| 1 | 97.83 | 368 |
| 2 | 98.28 | 348 |
| 3 | 97.95 | 341 |
| 4 | 98.5 | 334 |
| 5 | 98.78 | 328 |
| 6 | 98.73 | 316 |
| 7 | 97.33 | 300 |
| 8 | 96.2 | 368 |
| 9 | **76.28** | 371 |
| 10 | 99.42 | 347 |
| 11 | **57.77** | 341 |
| 12 | 98.19 | 332 |
| 13 | 99.07 | 323 |
| 14 | 98.73 | 314 |
| 15 | 99.67 | 304 |
| Total | **93.97** | 5404 |

| Final Yield | | |
|---|---|---|
| Serial.Site Number | Bin Pass Yield | Retested Count |
| 0 | 96.66 | 0 |
| 1 | 98.42 | 14 |
| 2 | 99.43 | 5 |
| 3 | 99.11 | 1 |
| 4 | 98.6 | 26 |
| 5 | 96.06 | 106 |
| 6 | 97.97 | 32 |
| 7 | 98.38 | 14 |
| 8 | 97.55 | 5 |
| 9 | 97.59 | 0 |
| 10 | 98.86 | 6 |
| 11 | 95.63 | 0 |
| 12 | 99.09 | 0 |
| 13 | 99.1 | 12 |
| 14 | 99.37 | 4 |
| 15 | 96.52 | 42 |
| Total | **98.06** | 267 |

First Pass



Final



# High Volume Production Result

- **Wafers needing offline retest dropped from 17.4% to 5.67% after implementing shift site reprobe!!!**

Wafer Daily Output

1st

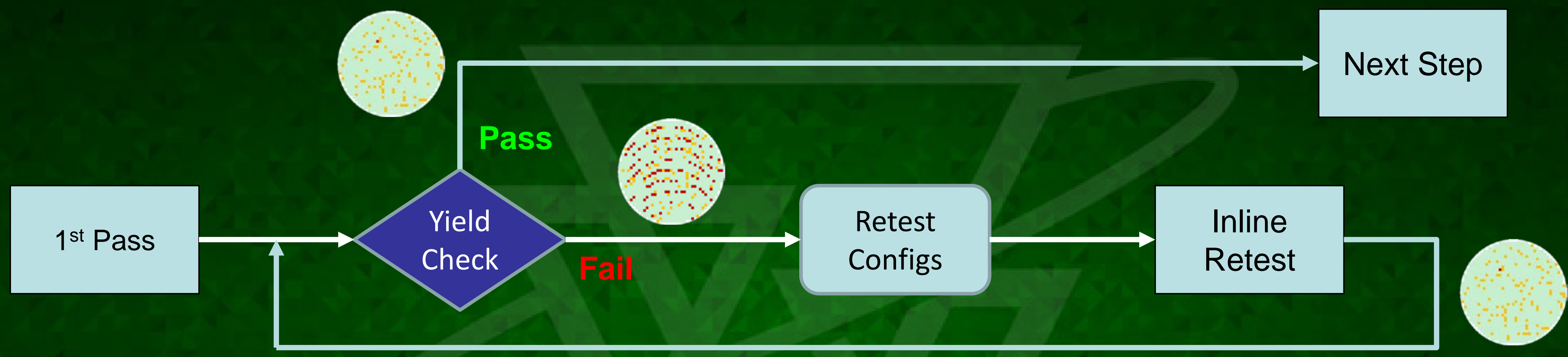
Retest

Traditional Flow

xREPROBE Shift Site Enabled

Aug Sep Oct Nov Dec Jan Feb

# Inline Retest Decision




- **Yield Check Rule:**
  - Yield
  - Soft Bin Limit
  - Site to site Yld & SBL
  - Pattern recognition
- **Retest configs:**
  - Which Bins to retest
  - Retest decision:
    - Minimize test time?
    - Maximize yield?

# xTEST's Portfolio

## xREPROBE

- Provides auto calculated reprobing path to minimize rescreen test time, maximize recovery yields, and allow production flexibility without downtime

## xCLEANING

- Provides proactive control in cleaning
  - Maintain target yield
  - Provide maximum throughput by only cleaning when needed

## xSETUP

- Auto-Z to setup prober for production environment and adjust overdrive on the fly
- Auto correlation / GRR for production setup

## xDATA

- Provides real time data analysis for alert , monitoring and probe decisions
- Setup data stream to any database upon request

# Thank you!!!

**Pai Chang**
**Teslence**
**P: +886-2-27472644**
**E: pai.chang@teslence.com**

**YK Huang**
**Teslence**
**P: +886-2-27472644**
**E: yk.huang@teslence.com**