

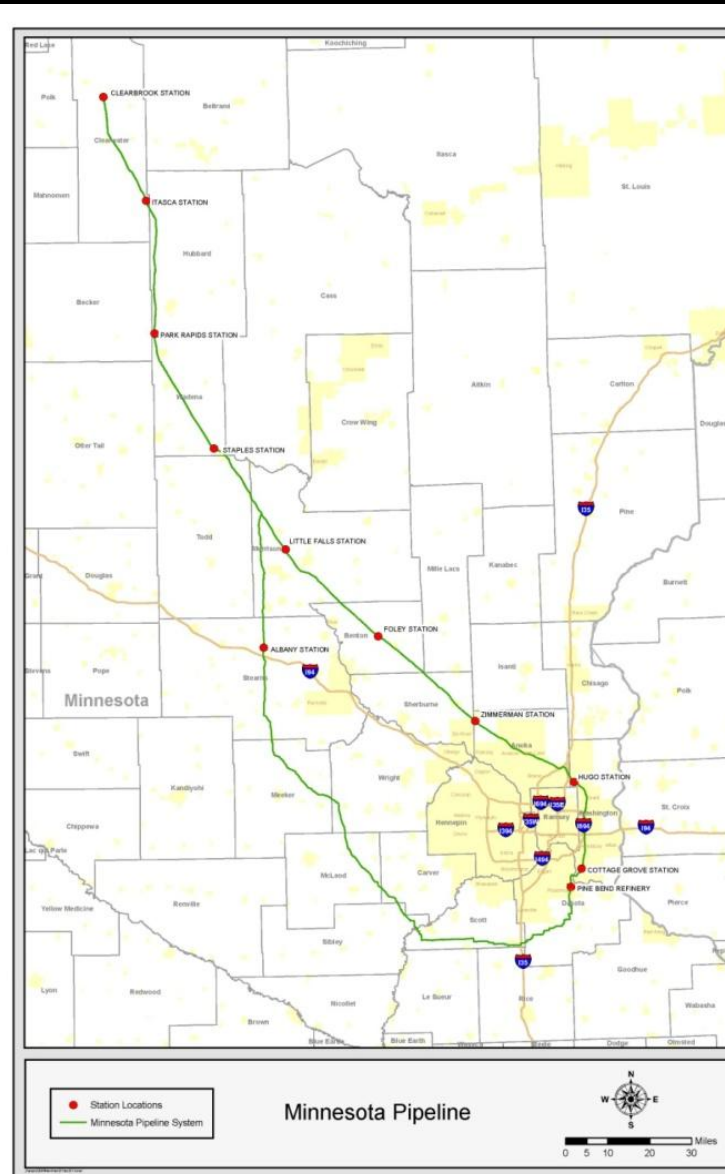
Inspection of Minnesota Pipelines MPL1, MPL2, & MPL4

Presentation Contents

- MPL Construction History
- Integrity Concerns - Cracking
- Inspection Tool Selection
- Reported Features and Findings - MPL1 & MPL2
- Combined MPL1 & MPL2 Field Verification Findings
- Findings – MPL4
- Conclusions

Minnesota Pipeline System Map

- MPL1, MPL2, & MPL4



MPL Construction History

MPL1, MPL2, and MPL4

MPL Construction History

- **MPL1**

- Commissioned in July 1955
- 199 miles of 16" 0.250 x 52 API 5L Low Frequency ERW
- 57 miles of 16" 0.281 x 52 API 5L SMLS
- 0.5 miles of 16" 0.500 Grade B API 5L SMLS
- Coal tar coating

MPL Construction History

■ MPL2

- Constructed in 1970's and 1980's
- Series of loop expansions for MPL1
- 189 miles of 16" 0.250 x 52/x60 API 5L High Frequency ERW
- 54 miles of 16" 0.281 x 60/x65 API 5L High Frequency ERW
- Tape coating

MPL Construction History

- **MPL4**
 - Constructed 2007-08
 - 288 miles of 24" 0.350 x 70 API 5L ERW
 - 8 miles of 24" 0.406 x 70 API 5L ERW
 - 7 miles of 24" 0.500 x 70 API 5L ERW
 - Fusion bonded epoxy coating

Integrity Concerns – Cracking

MPL1, MPL2, and MPL4

Integrity Concerns – Cracking

■ MPL1

- Toe cracks in Heat Affected Zone
- Hook cracks in ERW seam
- Gouging in small dents

■ MPL2

- Manufacturing defects in ERW seam
- Stress Corrosion Cracking
- Gouging in small dents

Integrity Concerns – Cracking

- **MPL4**
 - Potential hydrogen-assisted cracking in girth welds

Inspection Tool Selection

MPL1, MPL2, and MPL4

Inspection Tool Selection

■ MPL1

- To quantify the integrity concerns listed for MPL1, selected Ultrasonic Crack Detection Tool
- Tool characteristic assessment objectives
 - Repeatability, accuracy, and probability of detection
 - Characterization of actual size of cracks in pipeline to more accurately estimate fatigue life – current methodology is hydrostatic testing

Inspection Tool Selection

■ MPL2

- To quantify the integrity concerns listed for MPL2, selected Ultrasonic Crack Detection Tool
- Tool characteristic assessment objectives
 - Repeatability, accuracy, and probability of detection
 - Identification of seam features
 - Assist in defining the degree and location of Stress Corrosion Cracking

Inspection Tool Selection

■ MPL4

- To quantify the integrity concern listed for MPL4, selected Ultrasonic Circumferential Crack Detection Tool
- Tool characteristic assessment objectives
 - Detection of any occurrence of girth weld cracking
 - Inspection of each weld

Reported Features and Findings

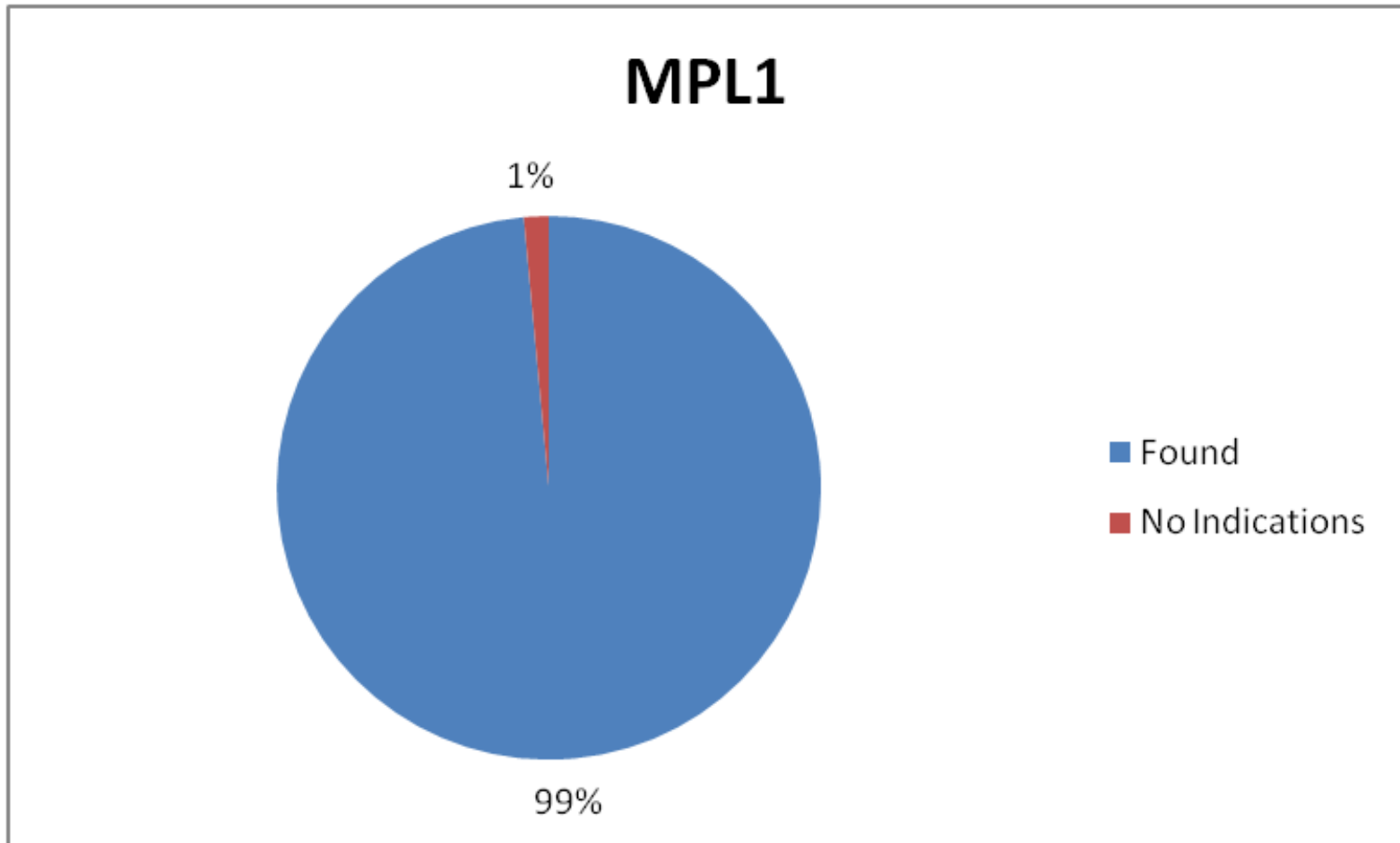
MPL1 and MPL2

MPL1 Reported Features and Findings

- 139 crack-like features
 - Field-evaluated all features called above detection limits of tool
- Gouges in dents
 - Correlated with previous inspection

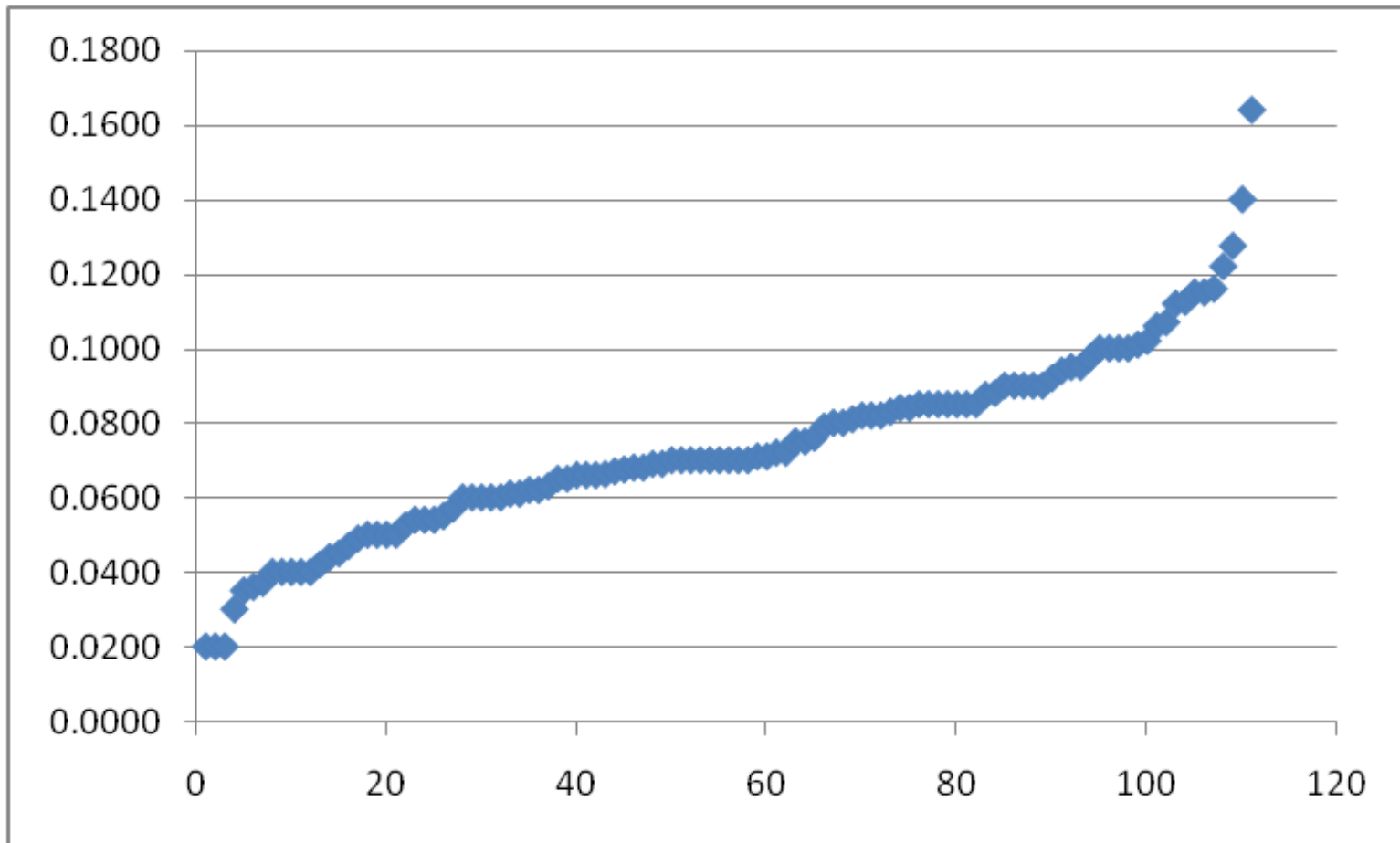
MPL1 Reported Features and Findings

- Confirmation of features called



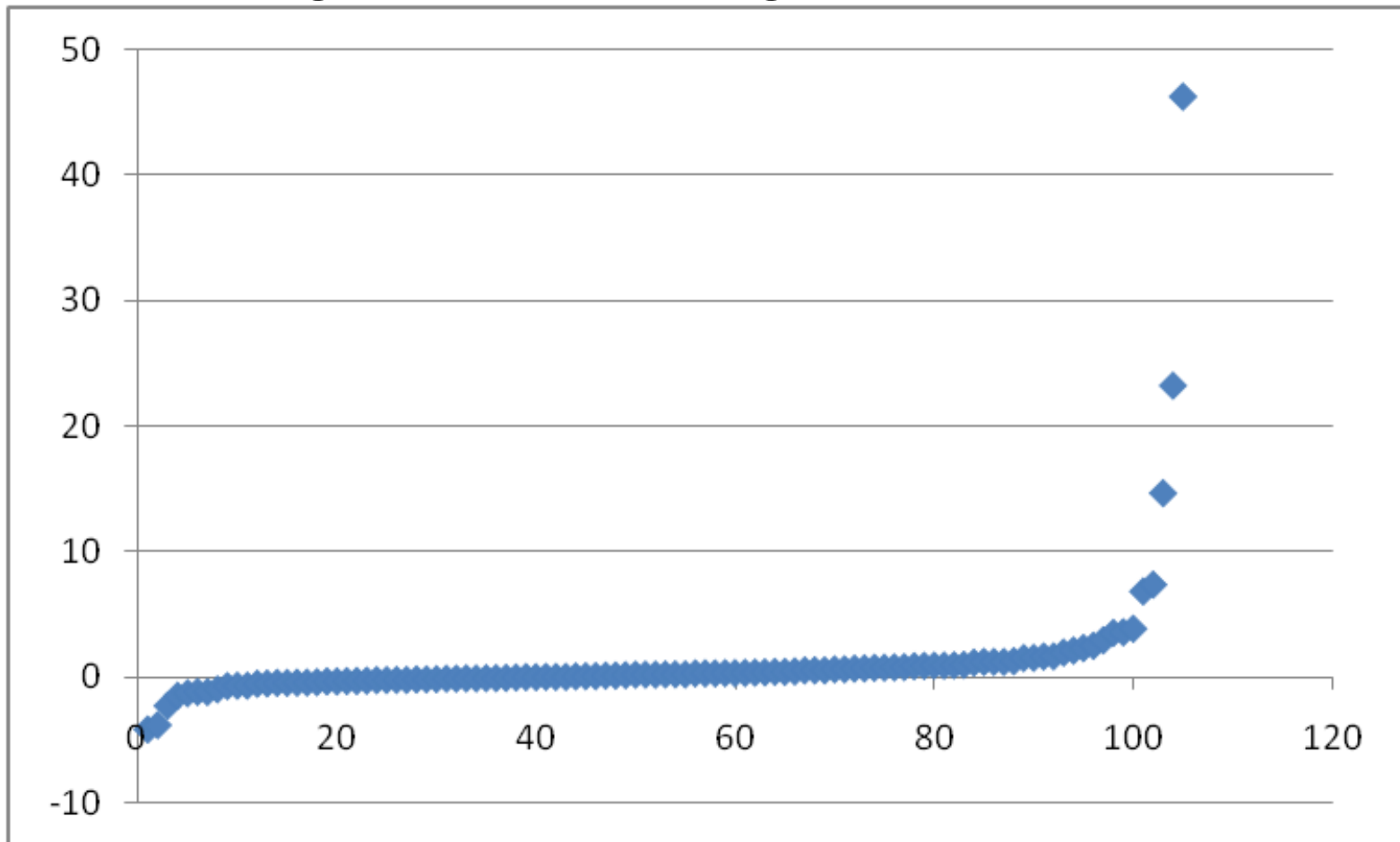
MPL1 Reported Features and Findings

- As-called depth vs. as-found depth (40-80 mil range)



MPL1 Reported Features and Findings

- As-called length vs. as-found length

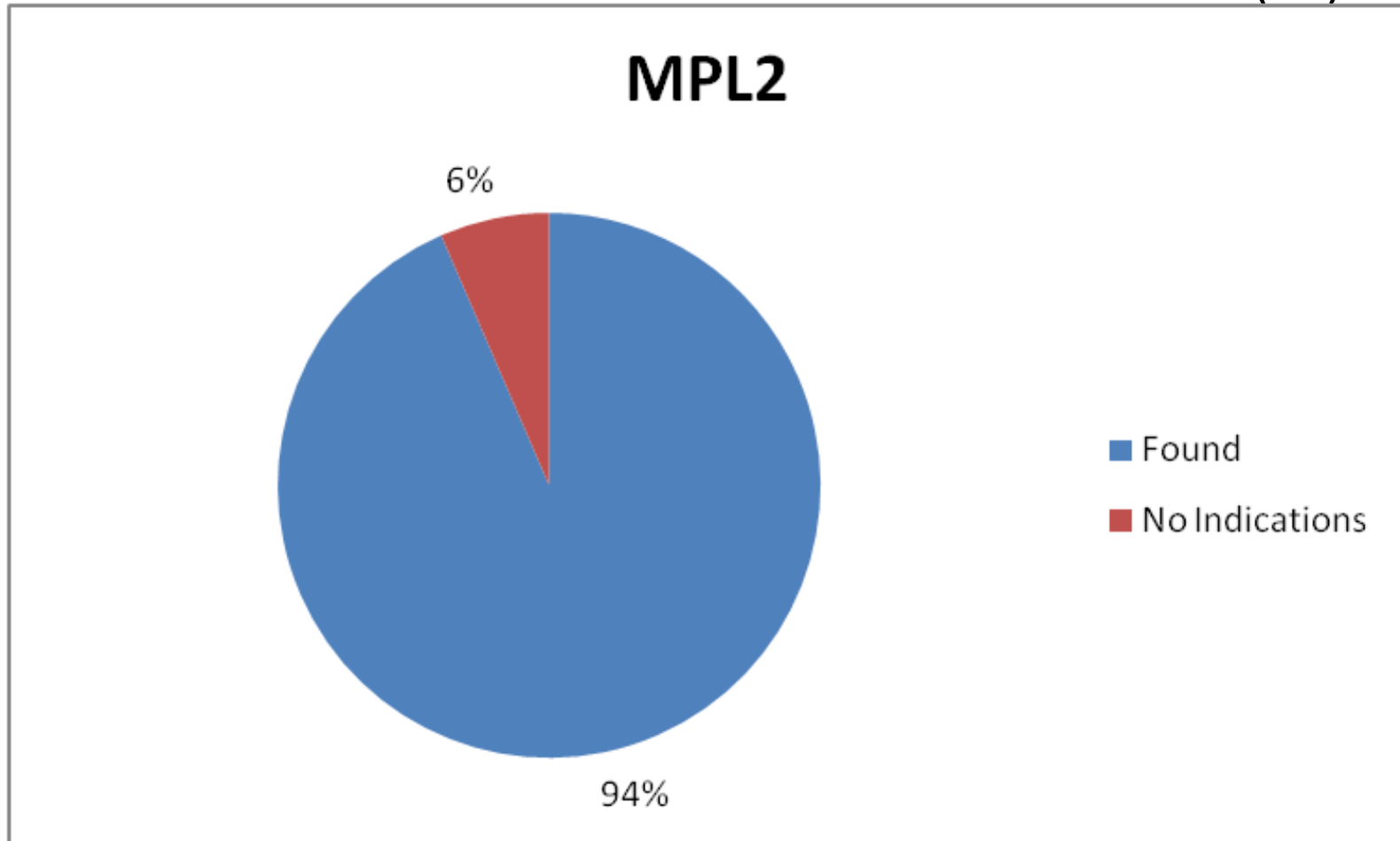


MPL2 Reported Features and Findings

- 340 crack-like features
- 10 crack field indications
 - Evaluated 10 crack fields
- Gouges
 - Correlated with previous inspection

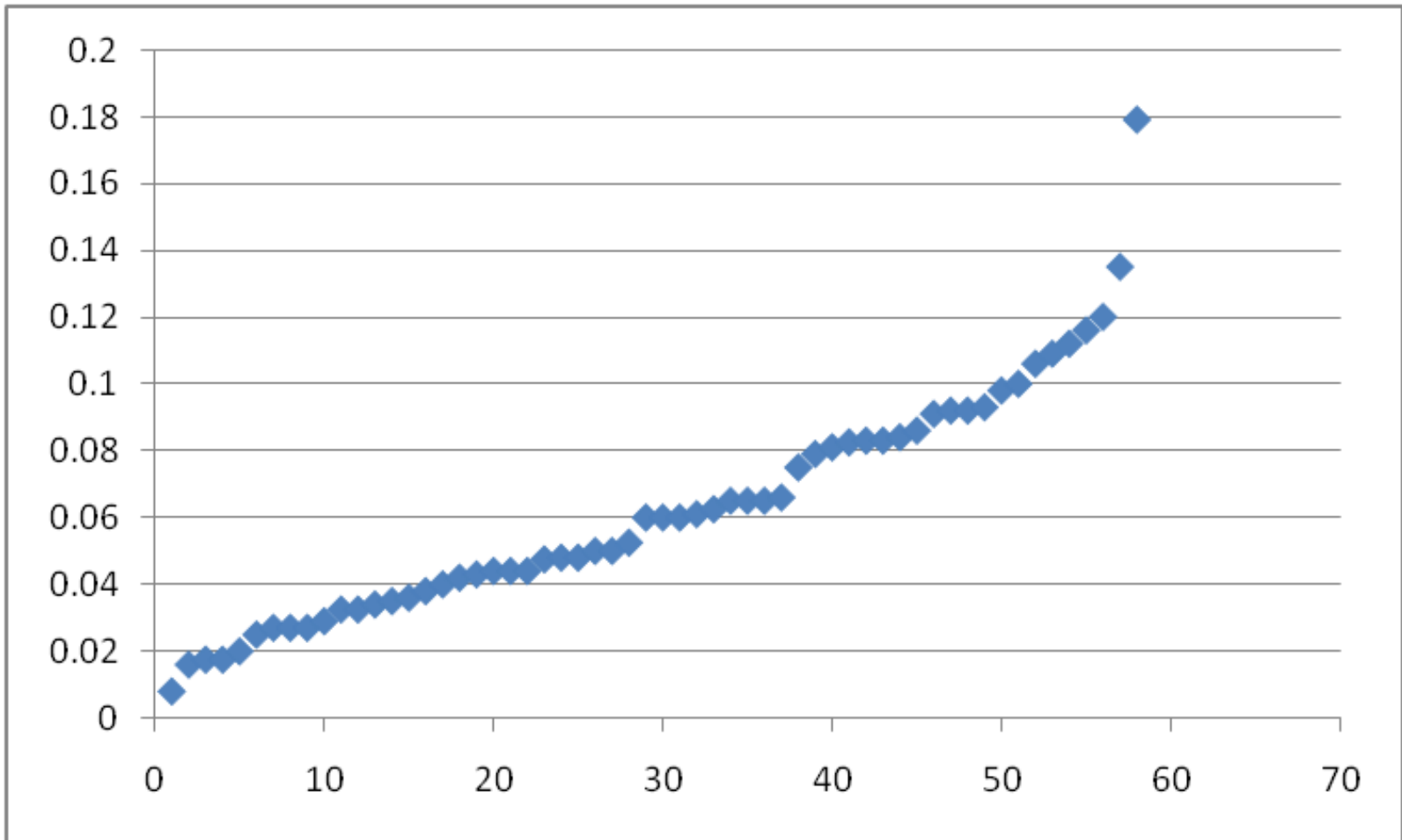
MPL2 Reported Features and Findings

- Confirmation of features as-called vs. field-evaluated (59)



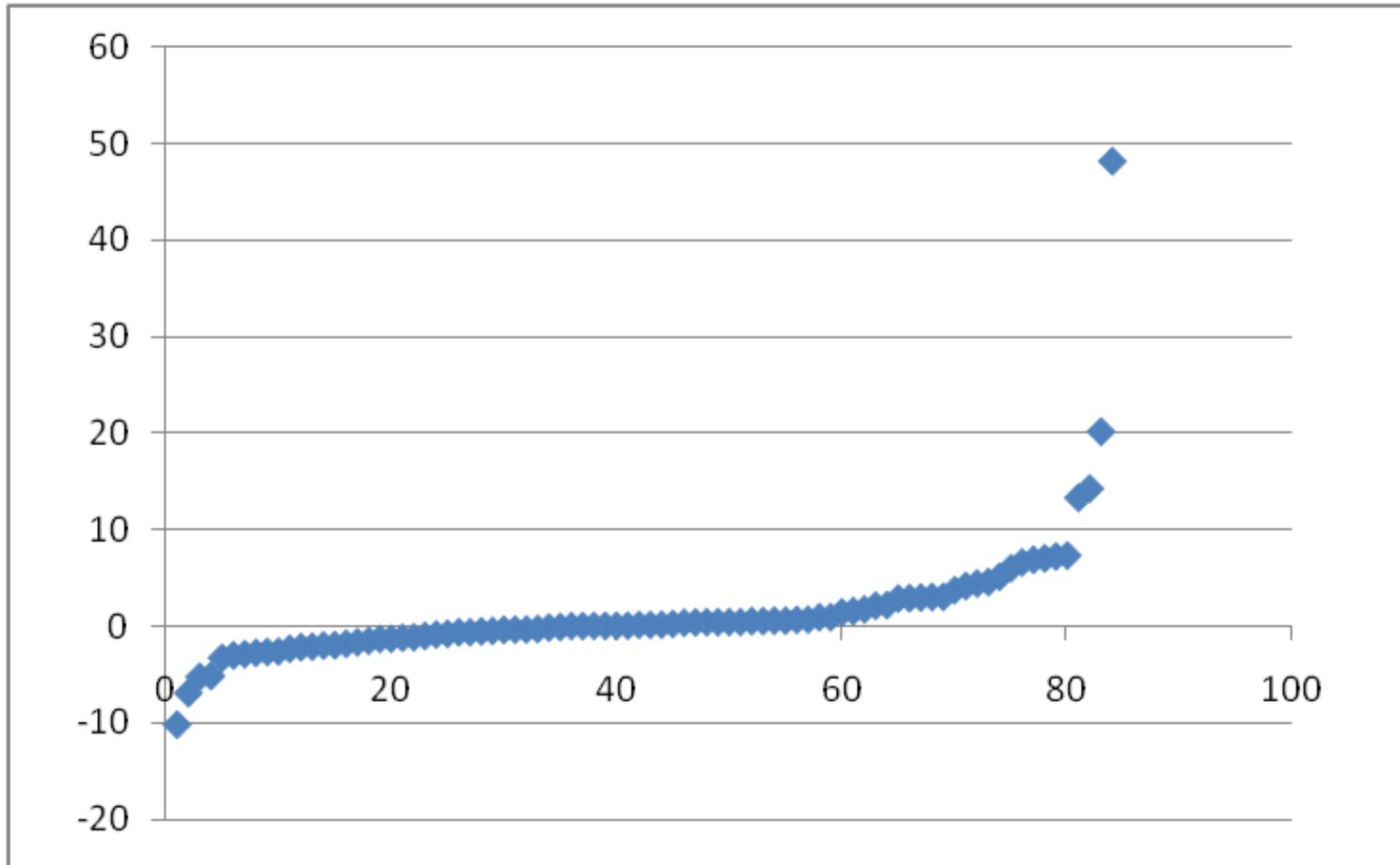
MPL2 Reported Features and Findings

- As-called depth vs. as-found depth (40-80 mil range) for field-evaluated features (59)



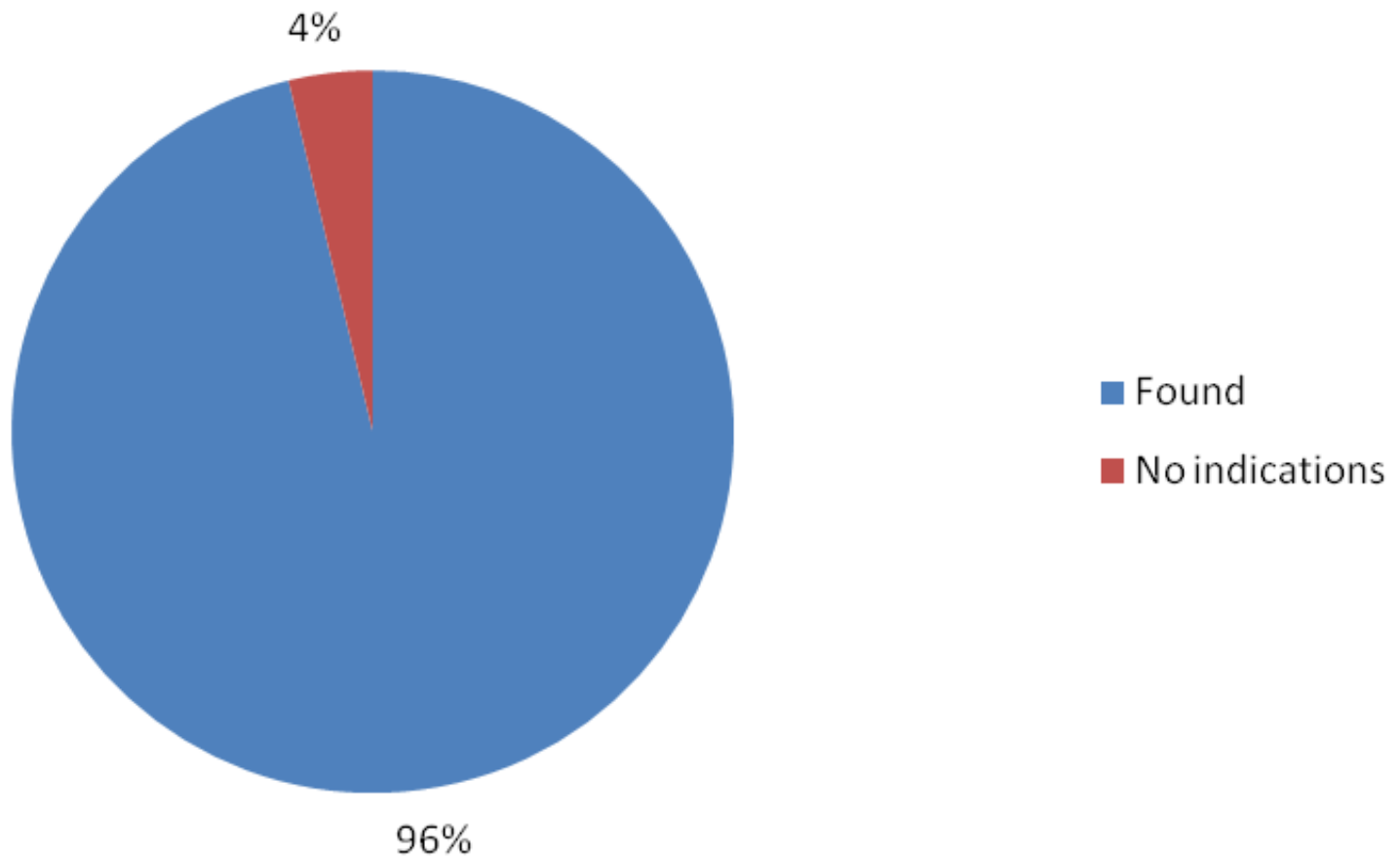
MPL2 Reported Features and Findings

- As-called length vs. as-found length for field-evaluated features (59)



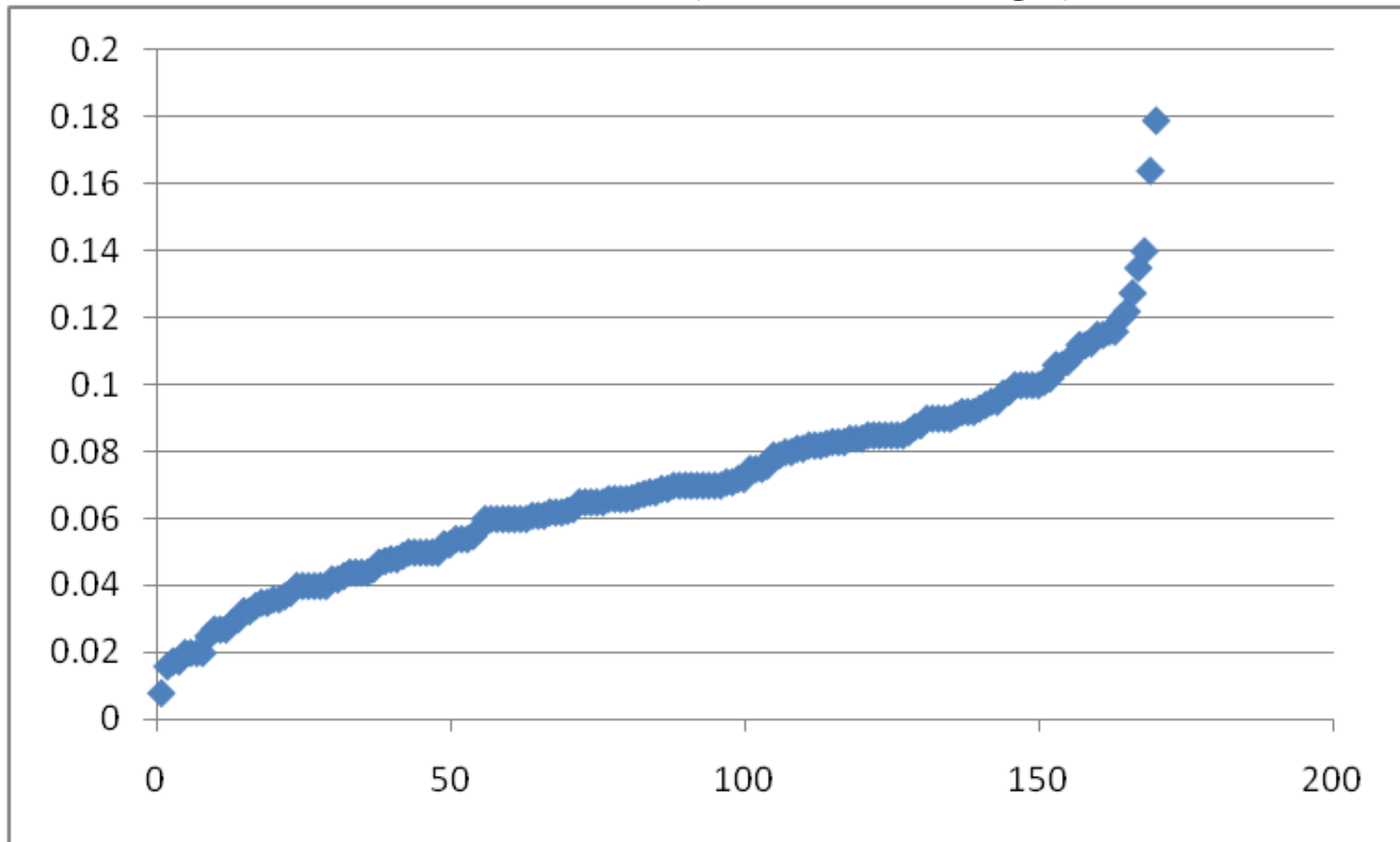
Combined MPL1 and MPL2 Field Verification Findings

Combined MPL1 and MPL2 Field Verification Findings



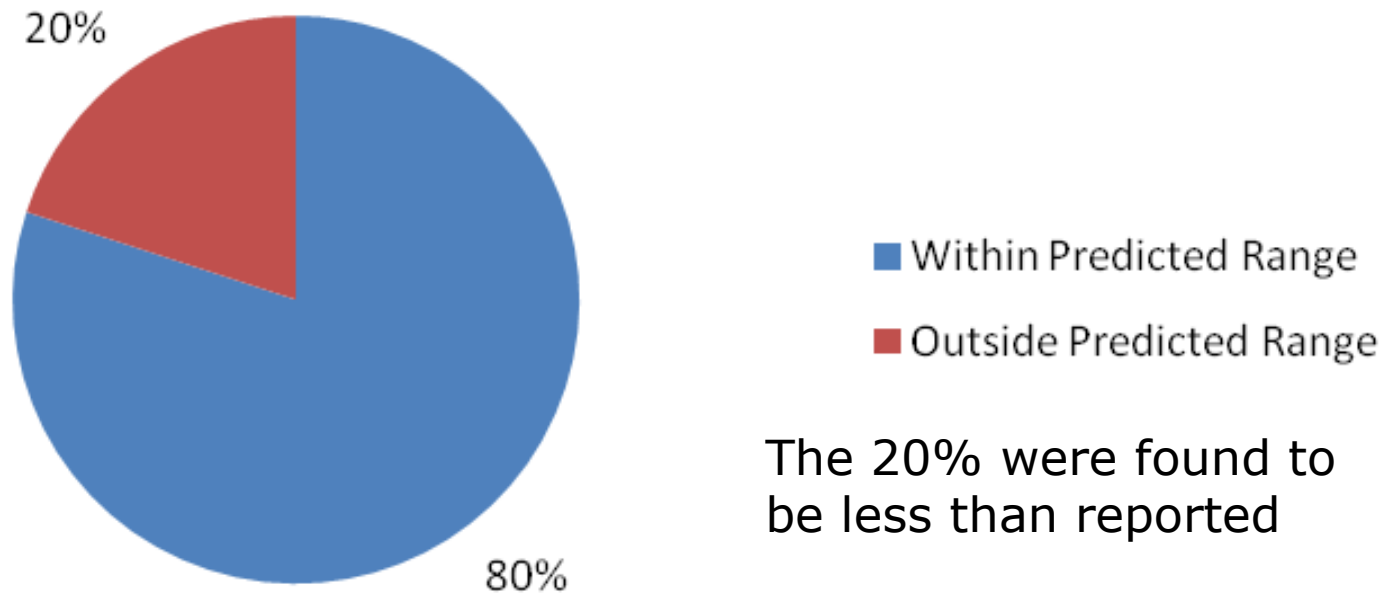
Combined MPL1 and MPL2 Field Verification Findings

- Predicted vs. field-evaluated (40-80 mil range)



Combined MPL1 and MPL2 Field Verification Findings

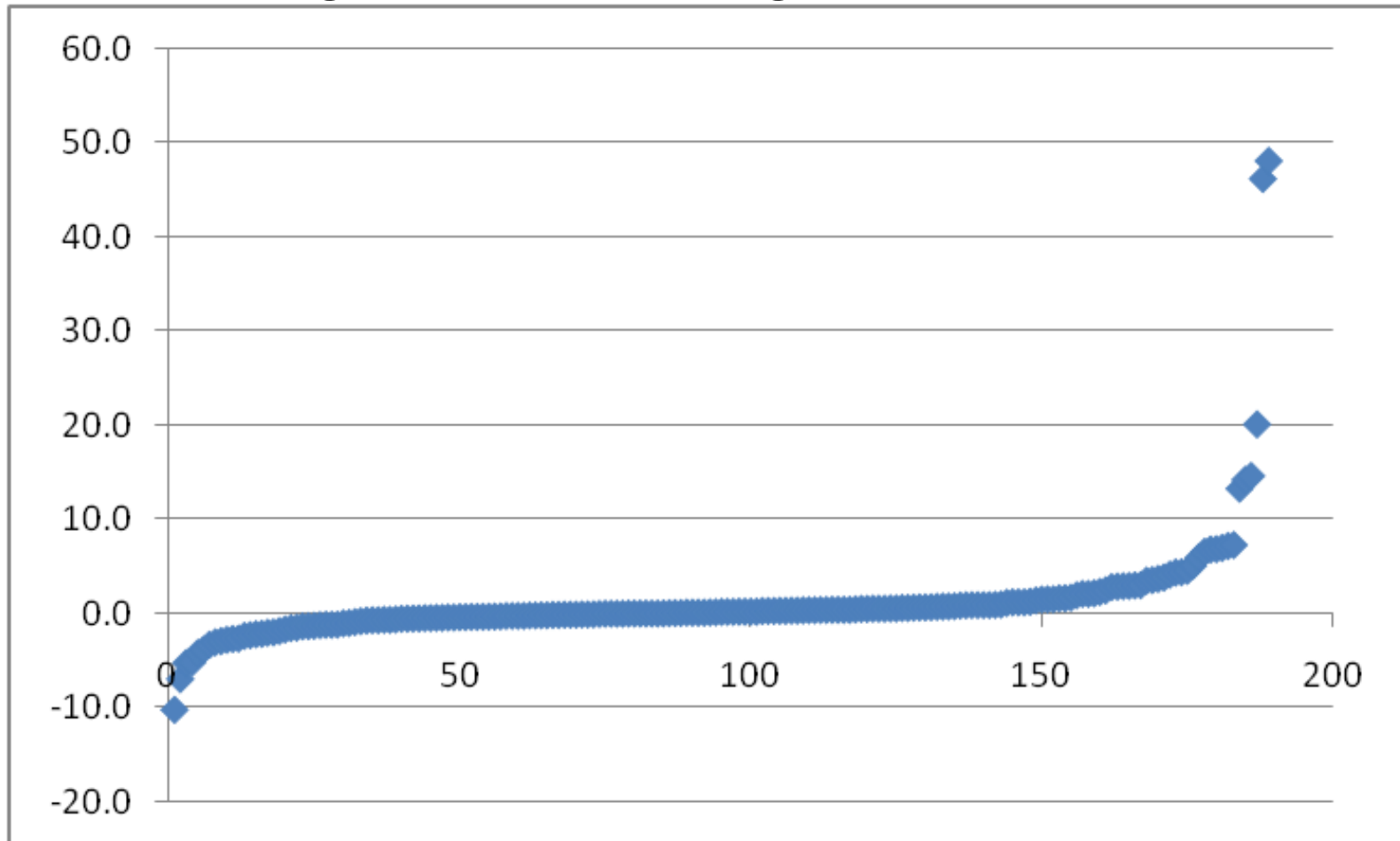
80-160
>160



The 20% were found to be less than reported

Combined MPL1 and MPL2 Field Verification Findings

- As-called length vs. as-found length



Findings

MPL4

MPL4 Findings

- 24,287 welds identified
- No reportable features above tool reported detection limits
- Asked for features below tool reported detection limits for correlation
- 25 correlation welds identified – 18 field-evaluated
- Compared as-called, radiographic, and field evaluation results
- Good correlation between as-called features to construction radiography film and field-evaluated results

Conclusions

- The predicted features correlated with field evaluations – few false calls
- Tool identified unanticipated ERW seam features in MPL2 that KPL remediated
- The combined graphs show the good consistency of tool results between the different pipelines
- Identified the need for a new tool to evaluate girth welds, which showed successful application

Questions?