

# Aspects of End-fire Glide Slope Flight Inspection

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# Disclaimer

This material is intended to provide a better understanding of end-fire systems but is NOT intended as a reference for flight inspection. Nothing herein is intended to modify any procedure or specification required by FAA.

# EFGS – Rear Antenna



# Objectives

- Minimize flight inspection (FI) time and costs
- Address common questions or issues related to end-fire commissioning
- Q&A after today – no cost telephone technical support at 703 904-0707 or email at [john.johnson@wattsantenna.com](mailto:john.johnson@wattsantenna.com)

# Overview of Topics

- Air-to-Ground Interdependencies
- Transverse Optimization and Descriptive Terms
- Transverse Structure Evaluation (Recommended Engineering Tolerance)
- Predicting Facility Performance from Transverse Structure Recordings
- ICAO Coverage - Reference Point for 5 and 8 Degree Clearance Runs

# Communication Air to Ground

- In difficult siting conditions, airborne data is necessary for precise optimization of end-fire antenna systems, in particular for category II/III facilities
- With image glide slope systems the lateral performance is related to the ground plane
  - Performance is controlled by adhering to siting and grading criteria and is not adjustable beyond that point

# Communication Air to Ground (Continued)

- The EFGS has the unique and beneficial capability for, but therefore require, optimization of the lateral performance of the glide slope
- Prior to airborne measurements, engineering can only predict lateral performance from ground data
- Flight inspection should either effectively describe, provide flight records to engineering, or downlink the transverse structure recordings

# Preliminary Requirements to Evaluate the Transverse Structure

- ILS 2 profile
  - Set course width (0.65 to 0.75 degree)
  - Set angle (CA +/- 0.05)
  - Evaluate SBP and symmetry
- ILS 3 profile
  - Set commissioned angle and determine structure roughness

# Requirements for Adjustments

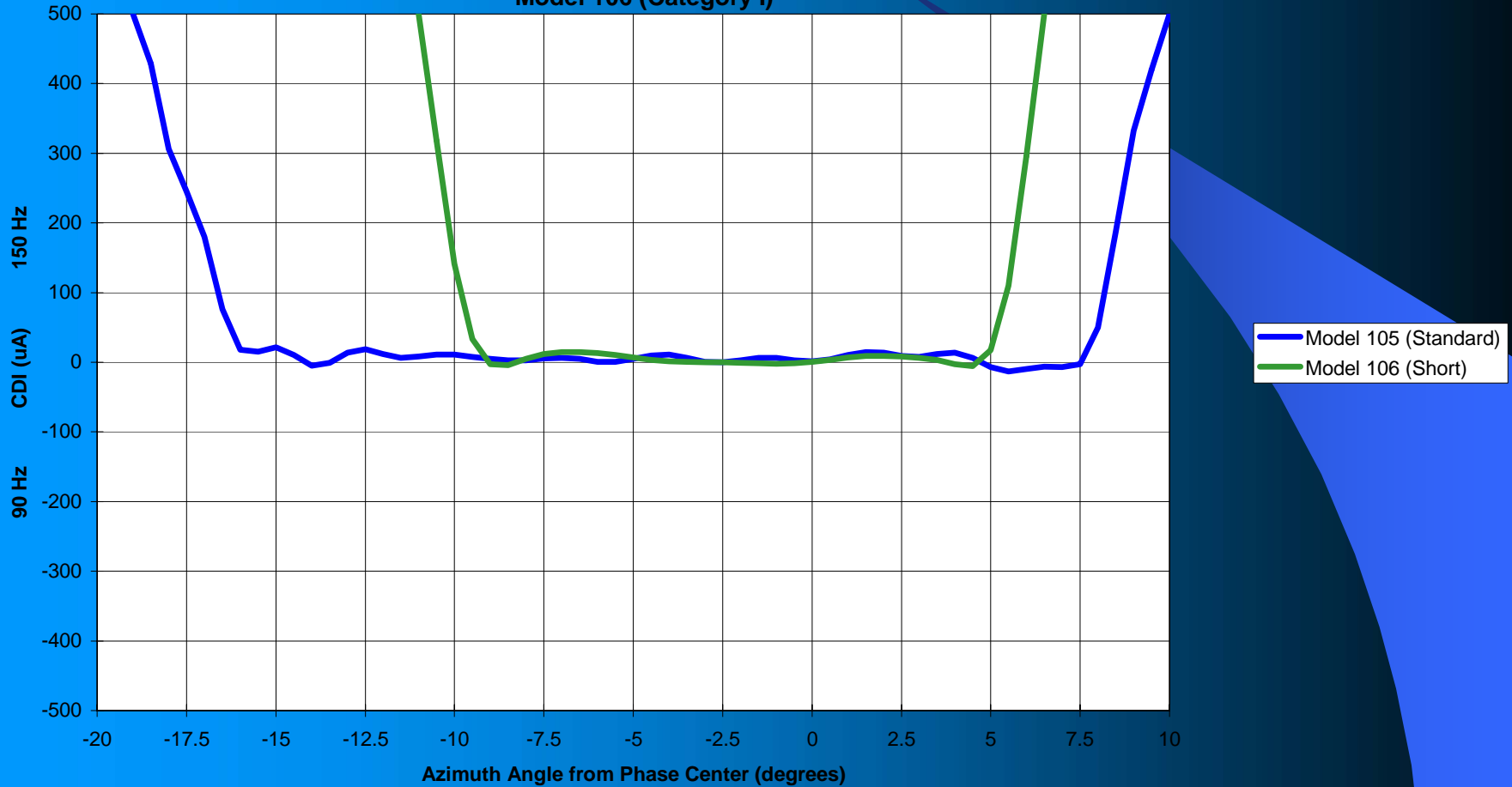
- Course only transverse structure
- Course and clearance composite
- Time to analyze flight recordings
- Confirmation of repeatable data taken in the same flight direction
  - If a multi-path source exists on one side of the approach, fly in the direction away from the reflector to gather the data

# Descriptive Terms

- Transverse Slope
- Transverse Flare
- Transverse Bowl
- Horns
  - Runway side
  - Array side
  - Both sides
  - Symmetric or Asymmetric Horns

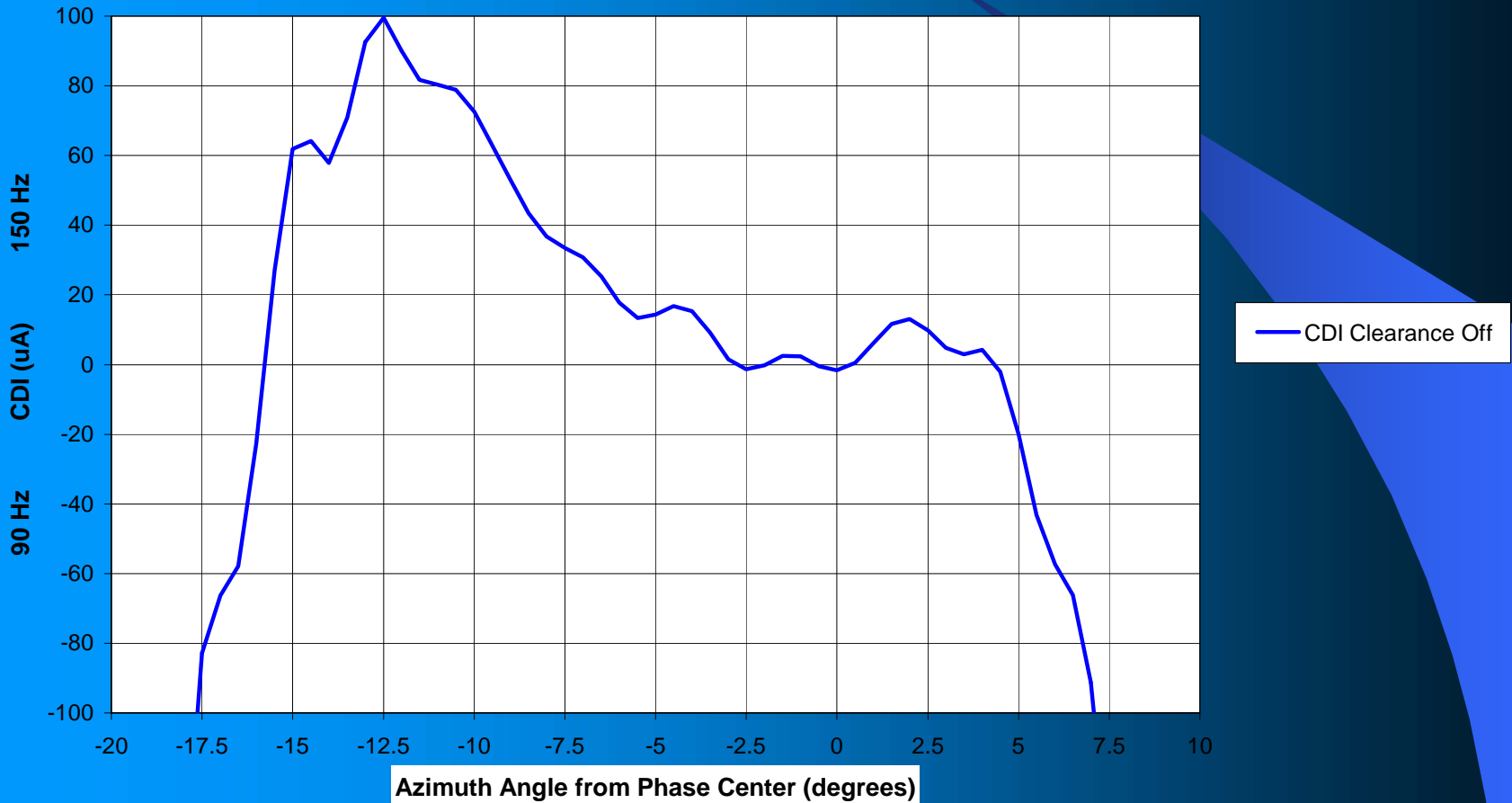
# Ideal - Transverse Trough

End-fire Glide Slope Theoretical CDI Patterns  
Model 105 (Category I or II)  
Model 106 (Category I)



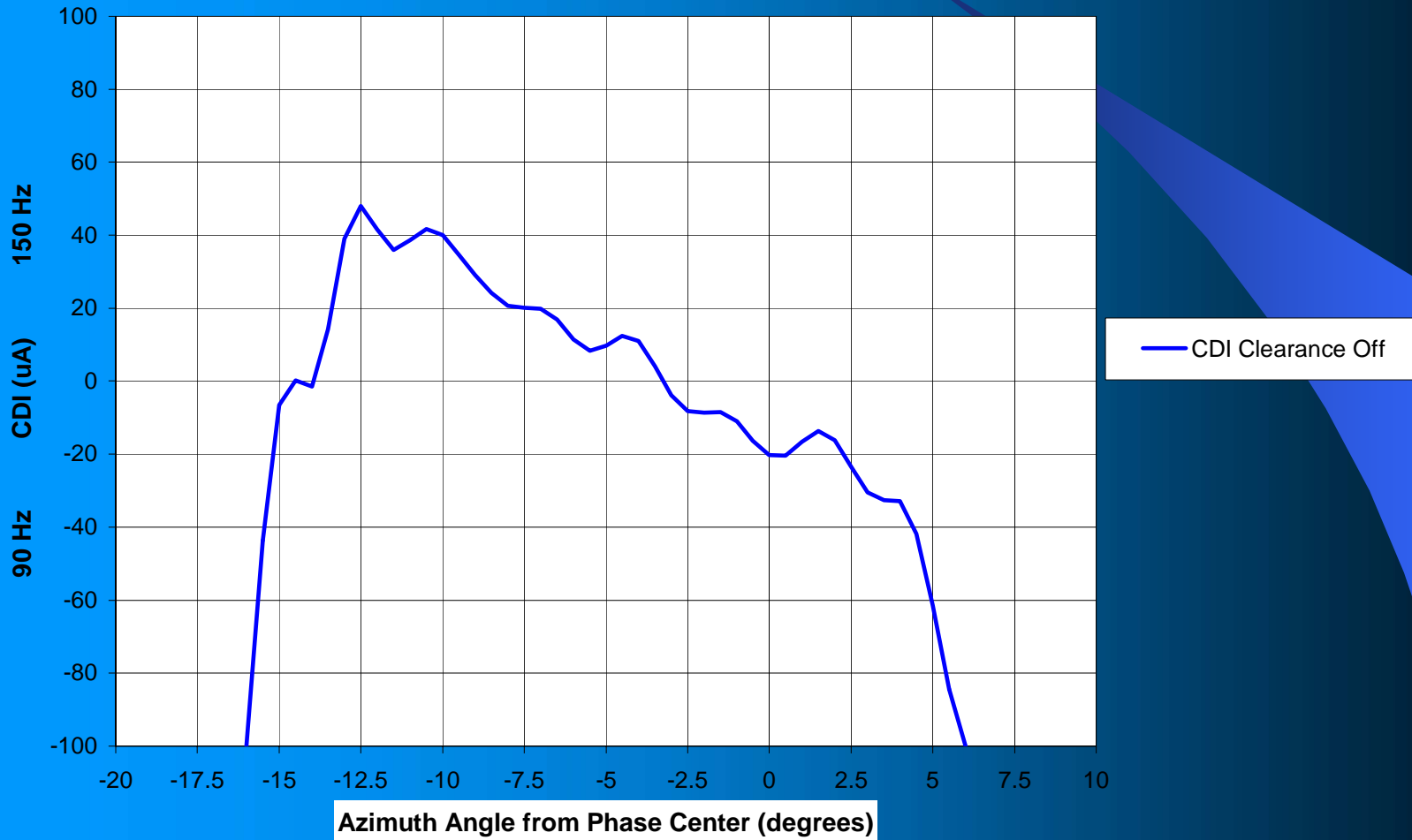
# Example - Transverse Flare

End-fire Glide Slope (Model 105)  
Modeled Transverse Flare



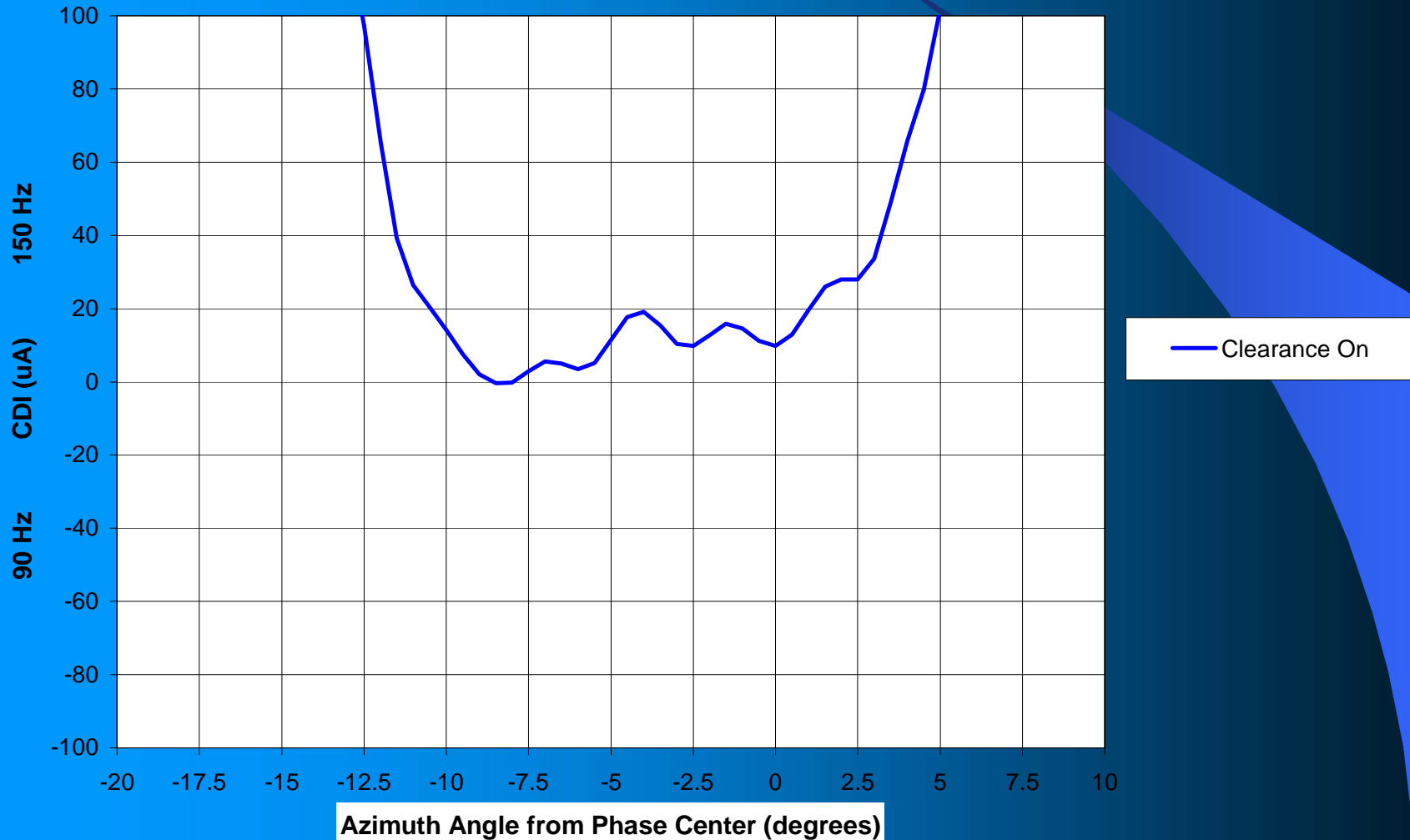
# Example – Transverse Slope

End Fire Glide Slope (Model 105)  
Modeled Transverse Slope



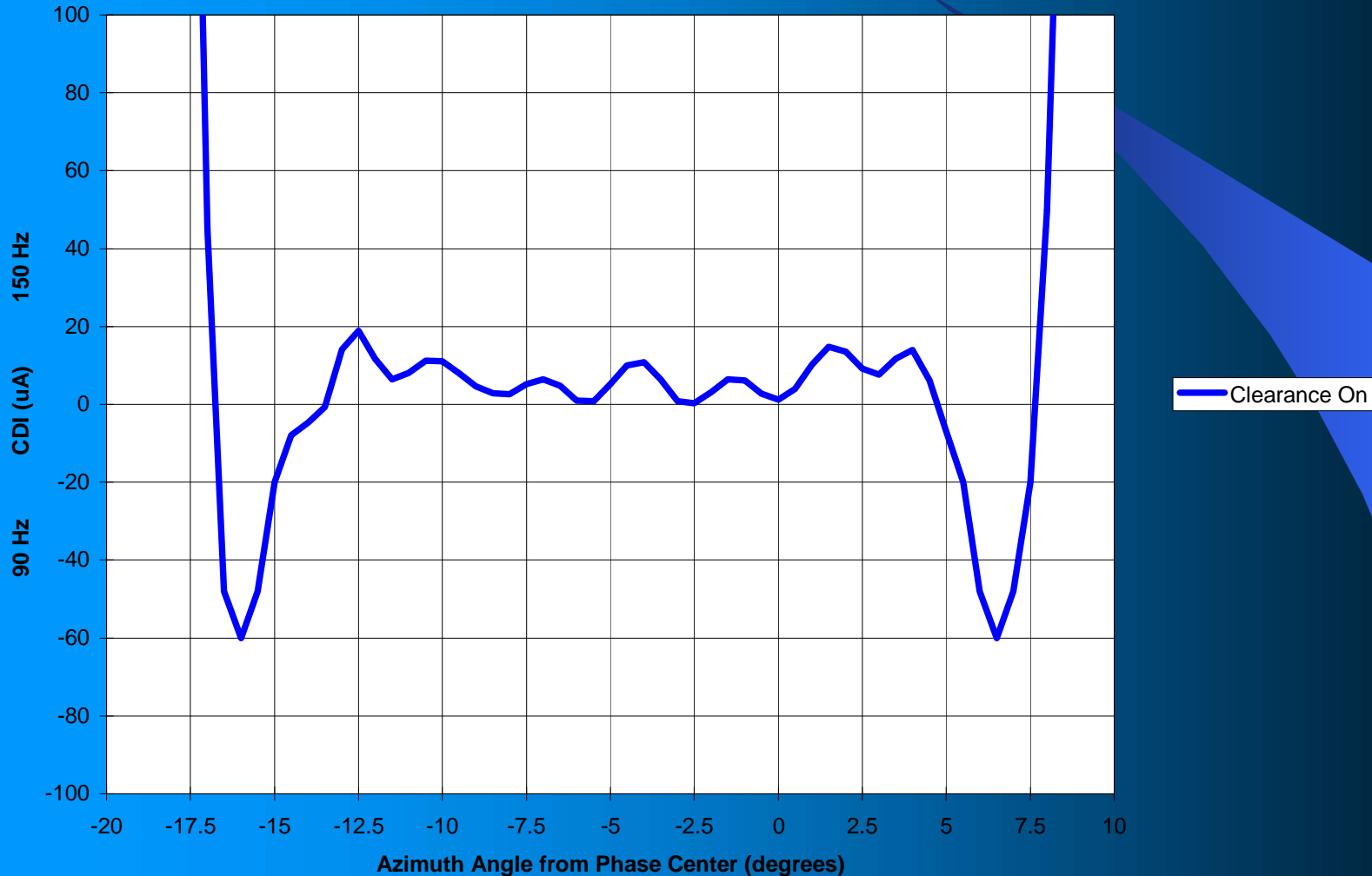
# Example – Transverse Bowl

End-fire Glide Slope (Model 105)  
Modeled Transverse Bowl



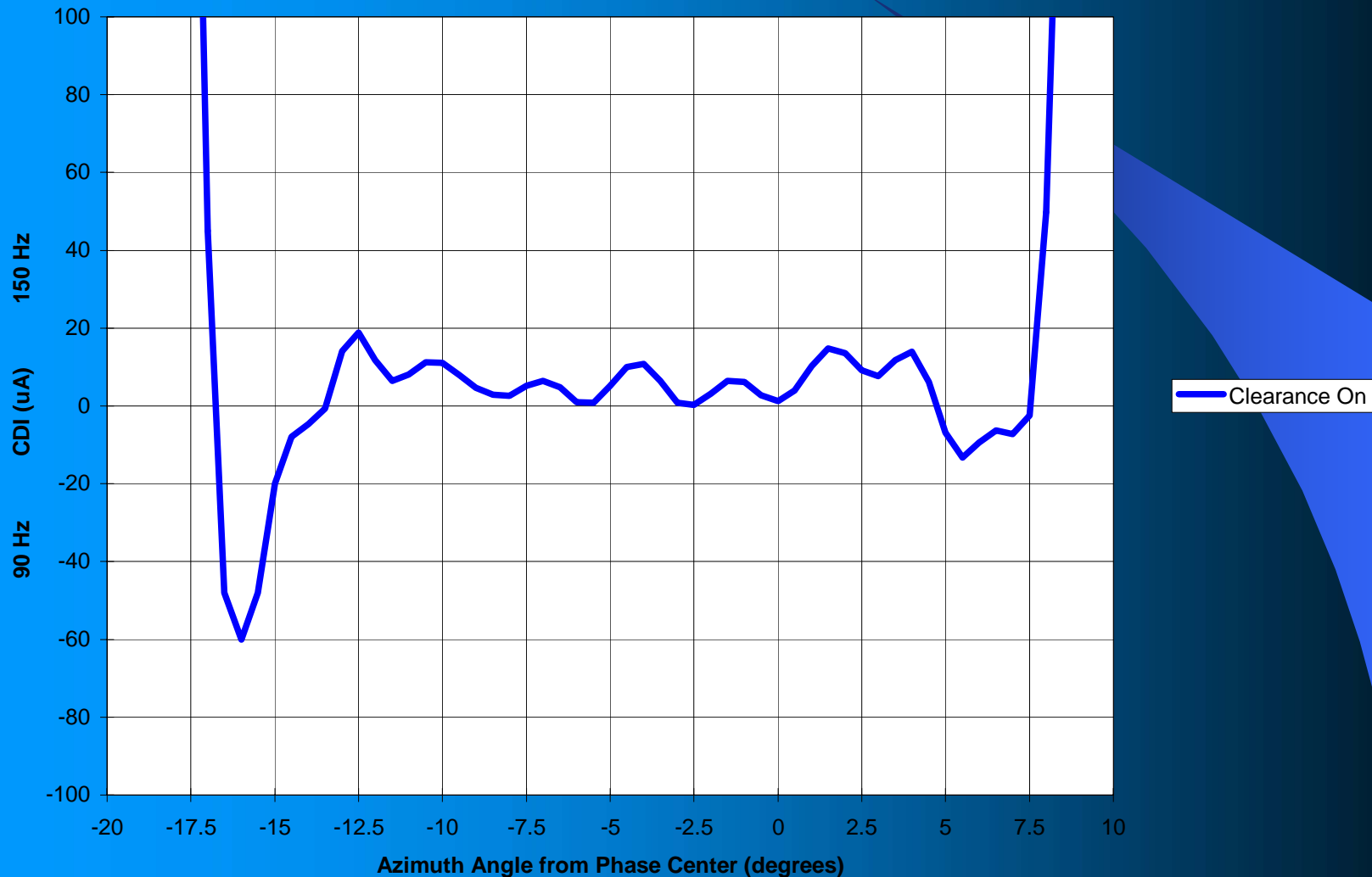
# Example – Symmetric Horns

End-Fire Glide Slope (Model 105)  
"Symmetric Horns"



# Example – Asymmetric Horns

End-Fire Glide Slope (Model 105)  
"Asymmetric Horns"

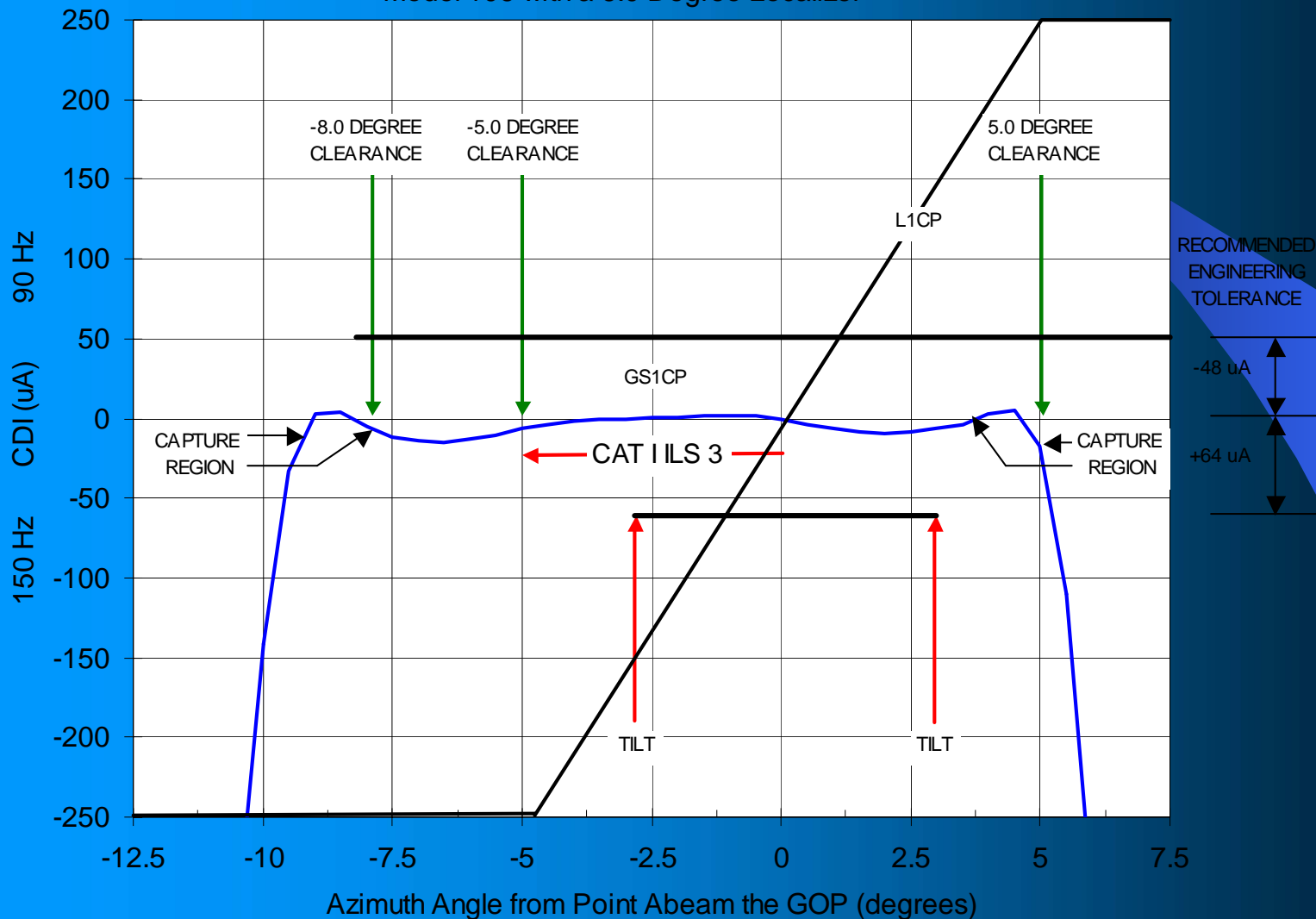


# Recommended Engineering Tolerance

- The tolerance is “recommended”
  - In severe siting conditions, a flat transverse structure may not yield an optimum or even an acceptable approach
- If the tolerance is exceeded
  - Engineering should determine that the condition is necessary and relevant flight profiles should be made that probe the affected area (tilt, SBP, clearances)

# “Recommended Tolerance”

Transverse Structure Analysis  
End-fire Glide Slope  
Model 106 with a 6.0 Degree Localizer

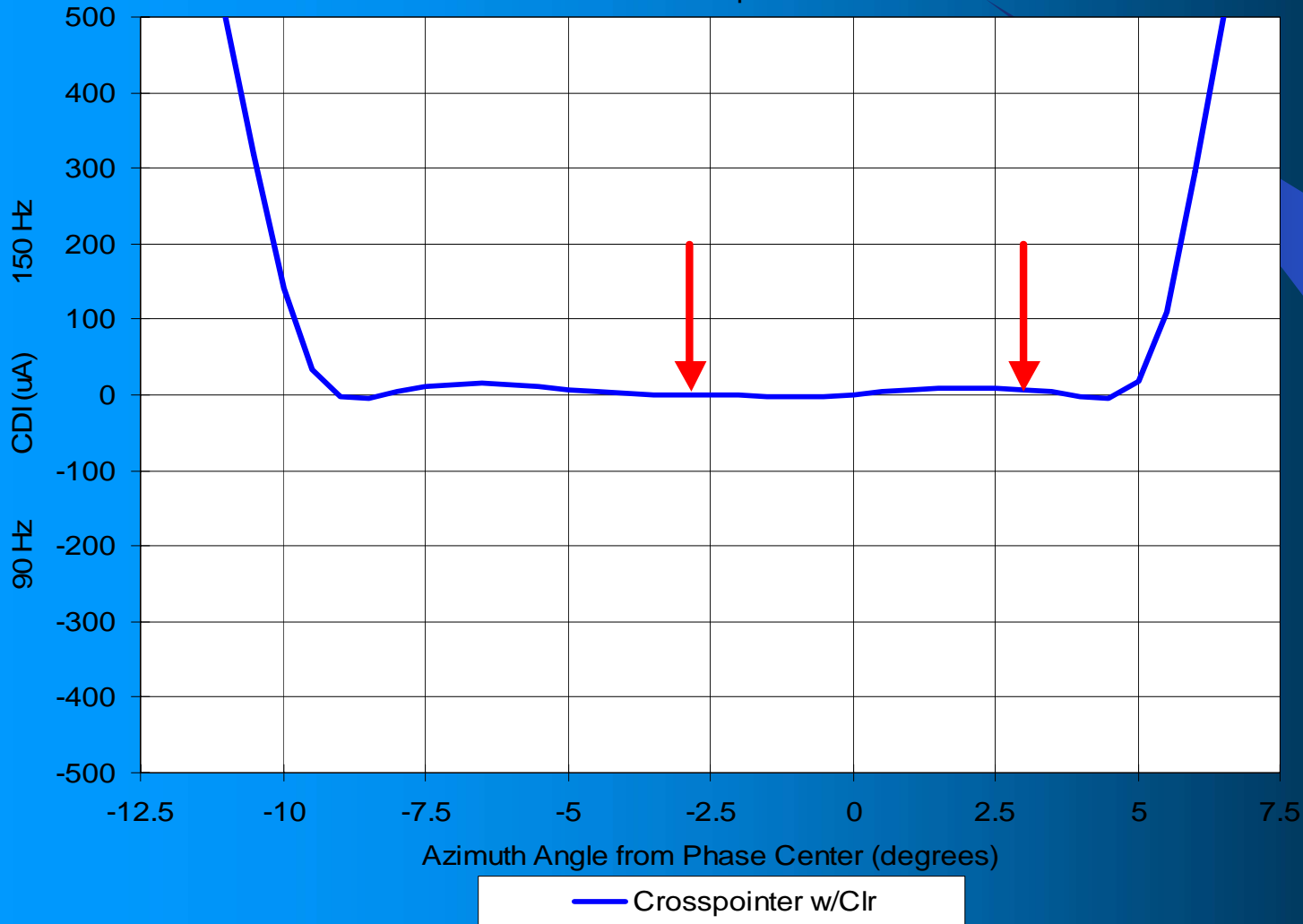


# Predictions Made from the Transverse Structure

- Tilt values – localizer extremities
- ILS 3 approach structure
  - 0 to 5.0 degrees = approach to point C clearance below-the-path
- Clearance below-the-path
- Clearance above-the-path

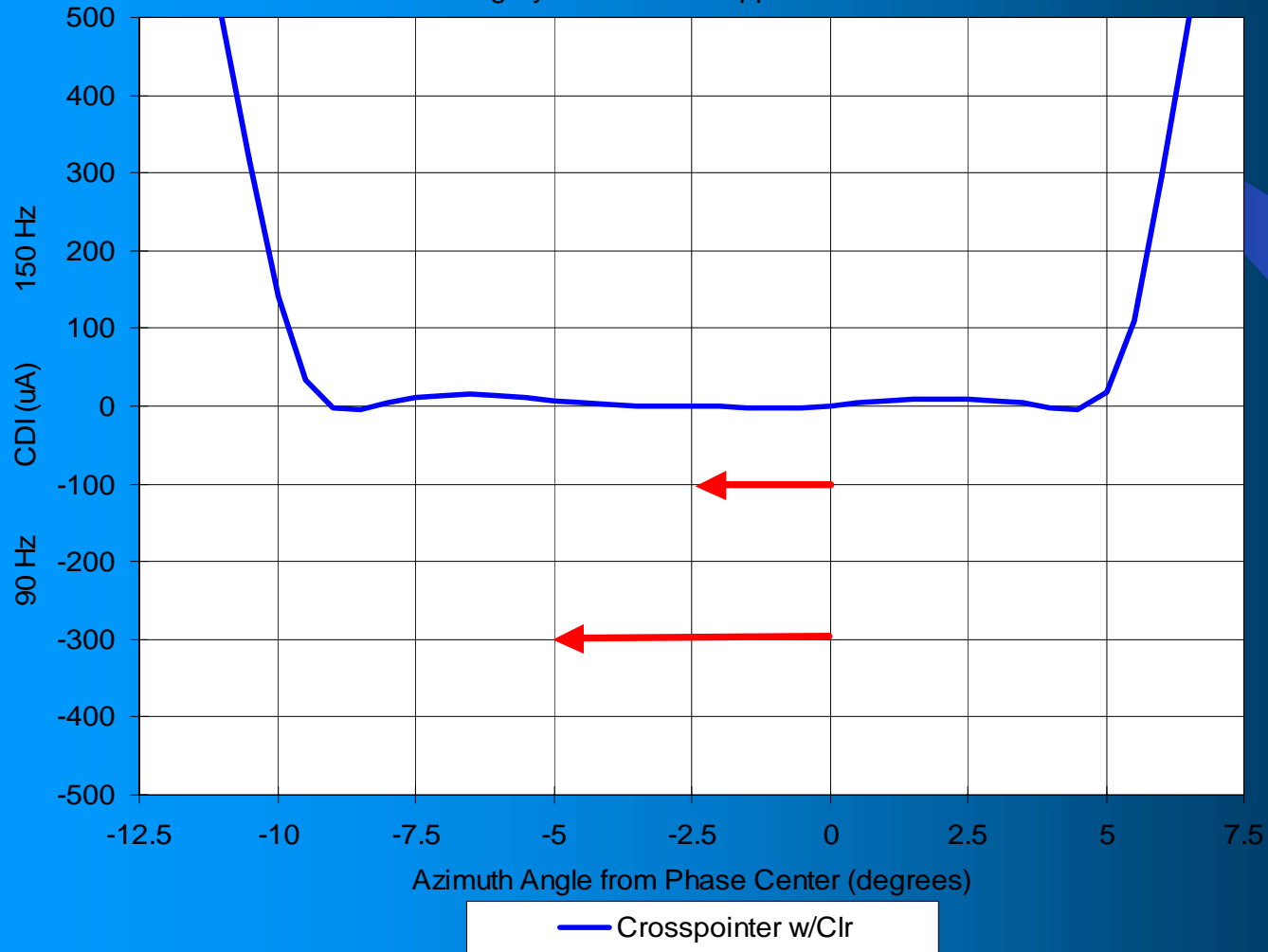
# Tilt Checks

End-fire Glide Slope (Model 106)  
Performance Predictions- 6 Degree Localizer  
Glide Slope Tilt



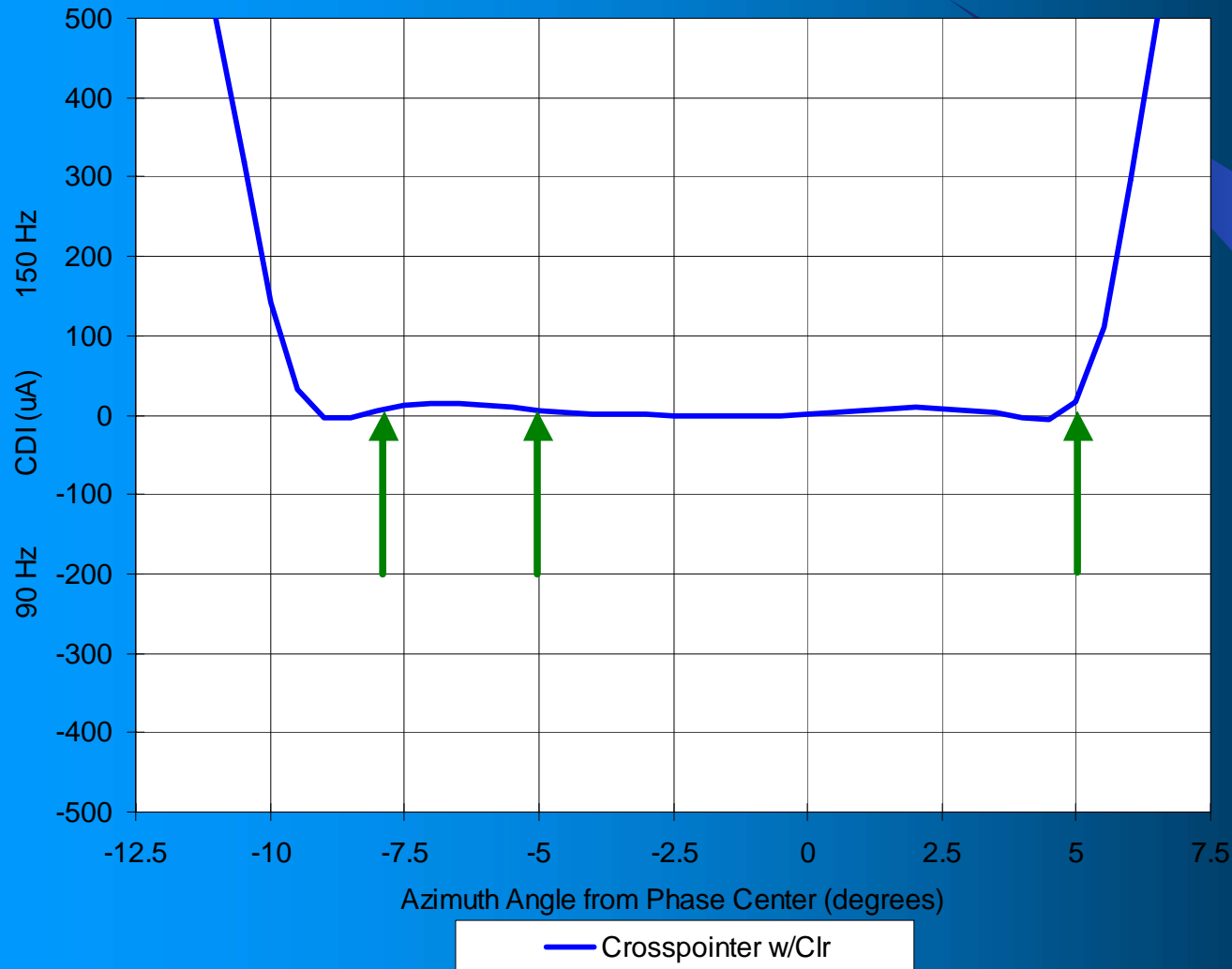
# ILS 3 – Approach Structure

End-fire Glide Slope (Model 106)  
Performance Predictions- 6 Degree Localizer  
Category I - Centerline Approach Structure



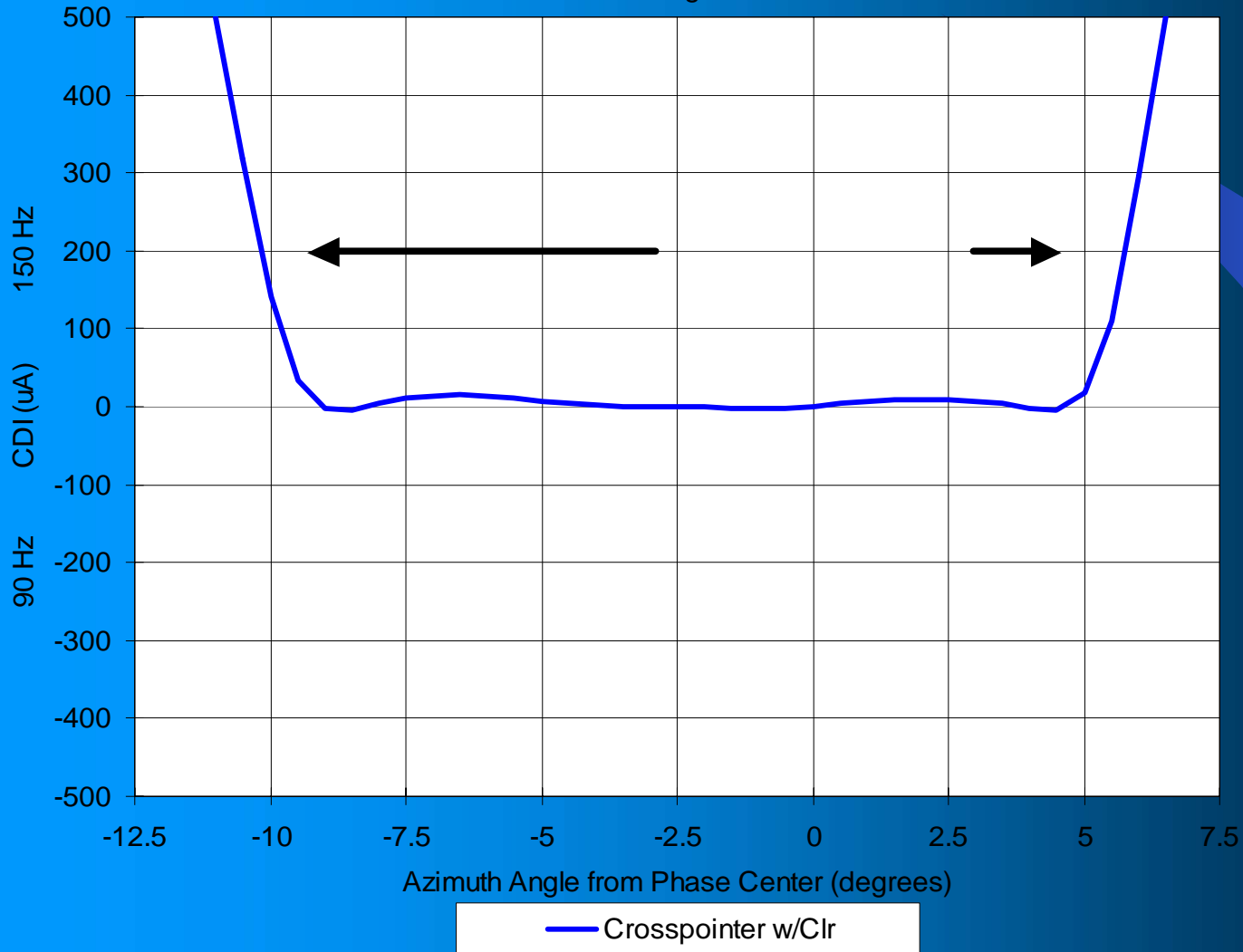
# Coverage and Clearances

End-fire Glide Slope (Model 106)  
Performance Predictions- 6 Degree Localizer  
Above and Below Path "Clearance" Predictions



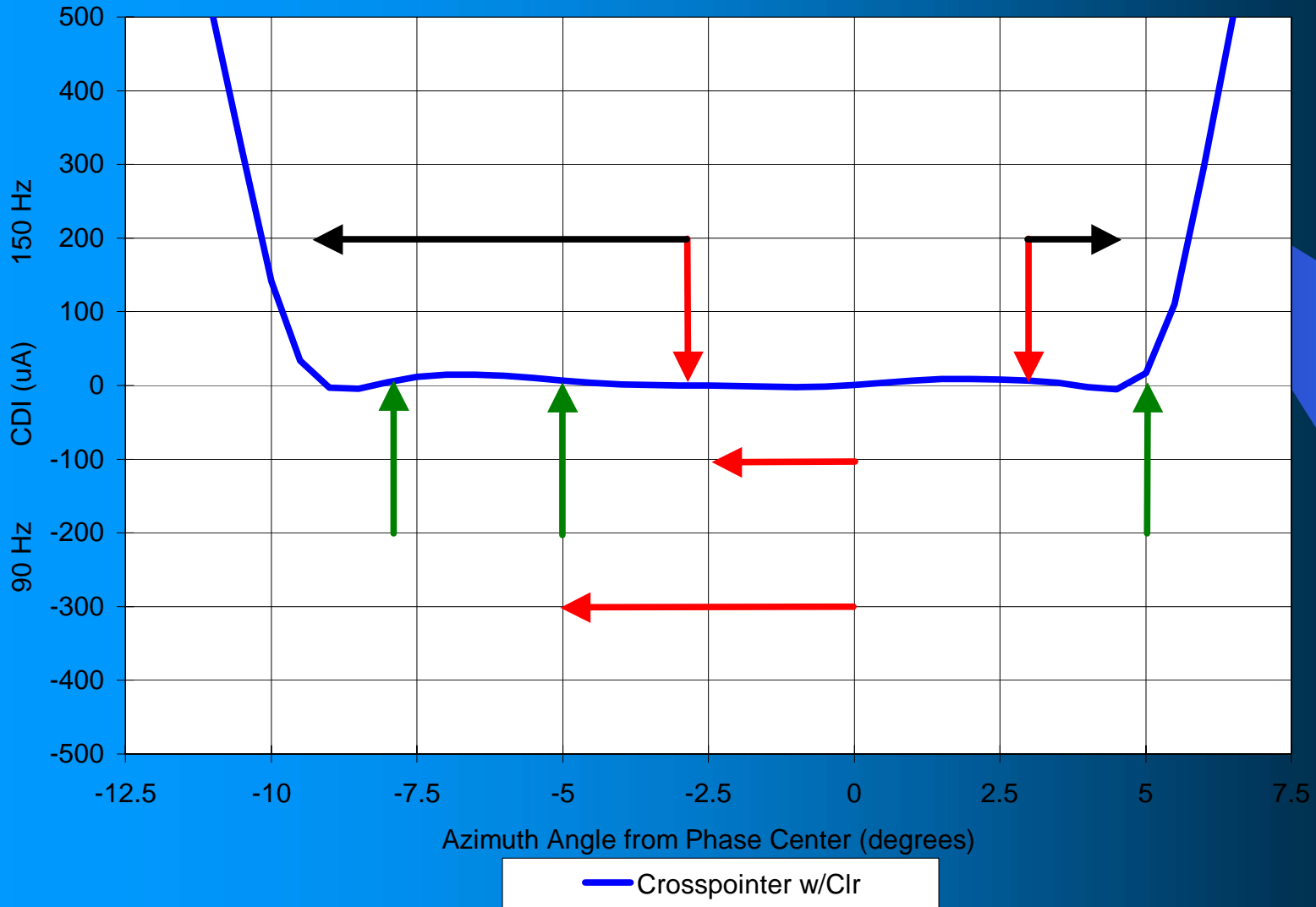
# Localizer Edges

End-fire Glide Slope (Model 106)  
Performance Predictions- 6 Degree Localizer  
Localizer Edge Structure



# Composite

End-fire Glide Slope (Model 106)  
Performance Predictions- 6 Degree Localizer

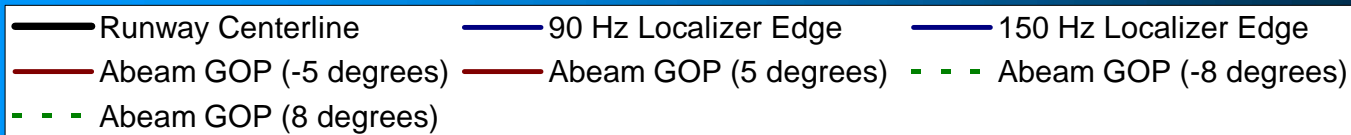
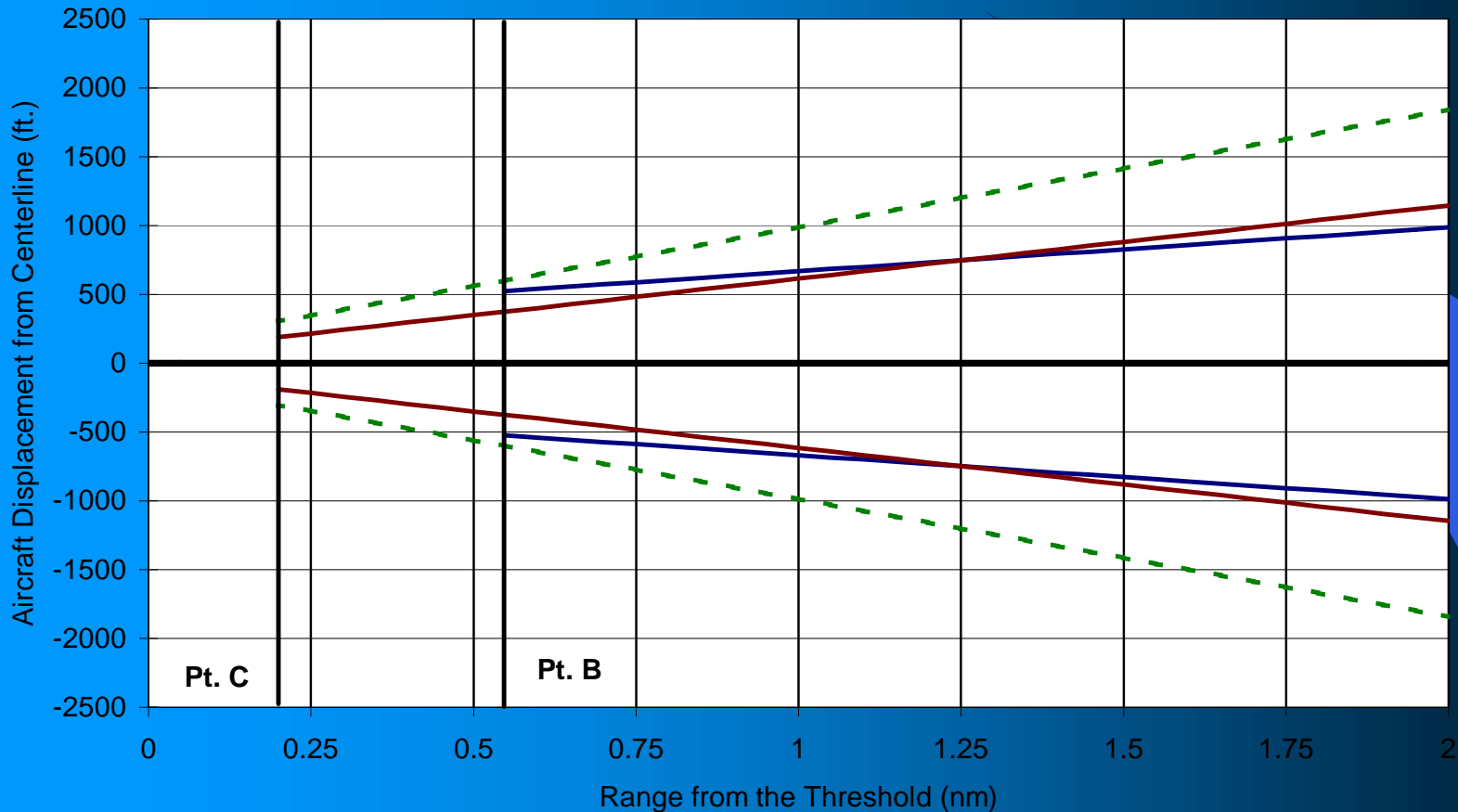


# Past Coverage Problems

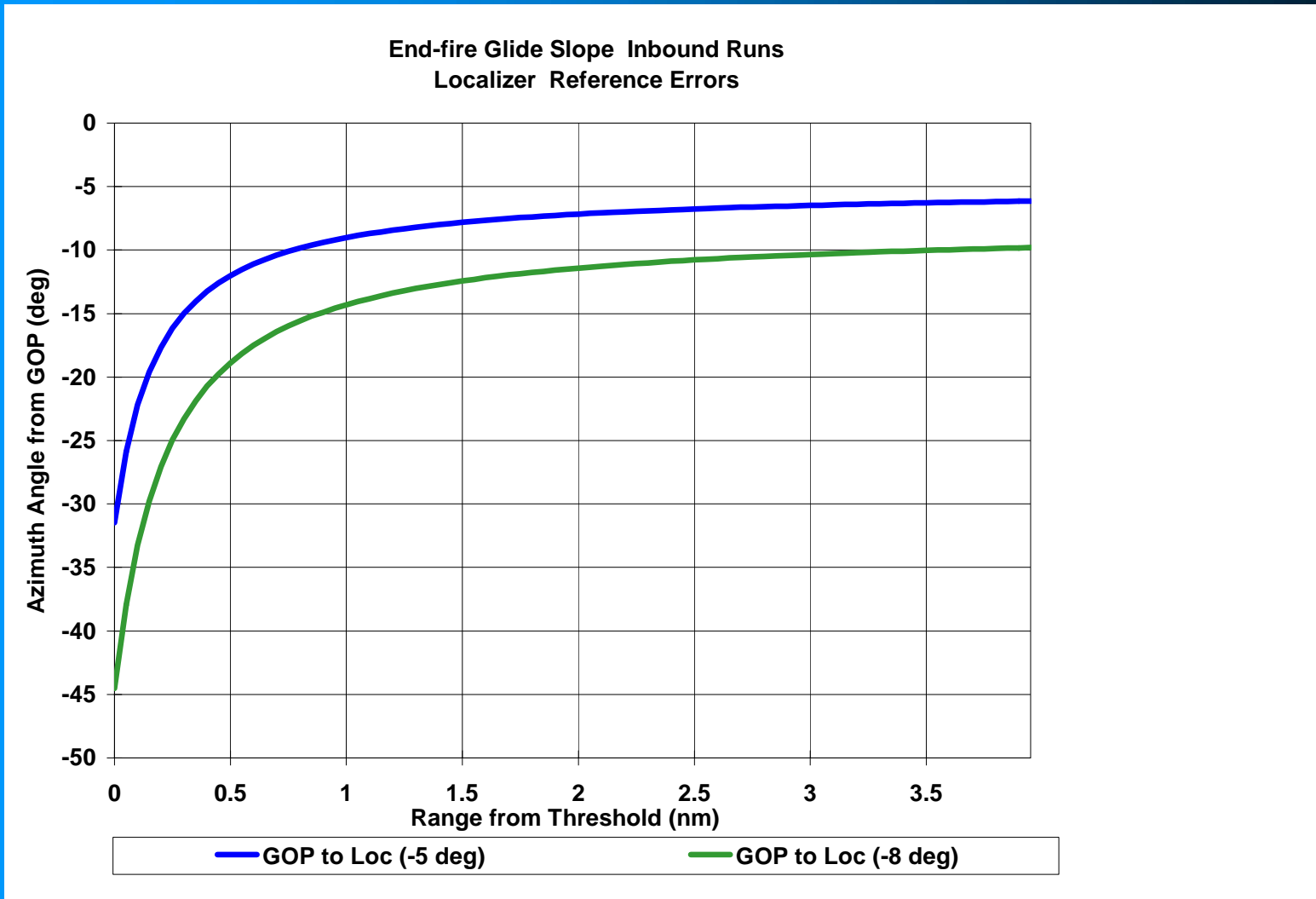
- Identified as reference point for inbound runs at 5 and 8 degrees
- Solution – As defined by ICAO, use glide slope point abeam the antenna as reference point
- Problem is only related to end-fire. Why?
- Inbound runs at 5 and 8 degree are only flown on end-fire glide slope systems

# End-fire Inbound Runs

End-fire Glide Slope Flight Measurement Profiles  
Inbound Tracks for Category I Evaluation

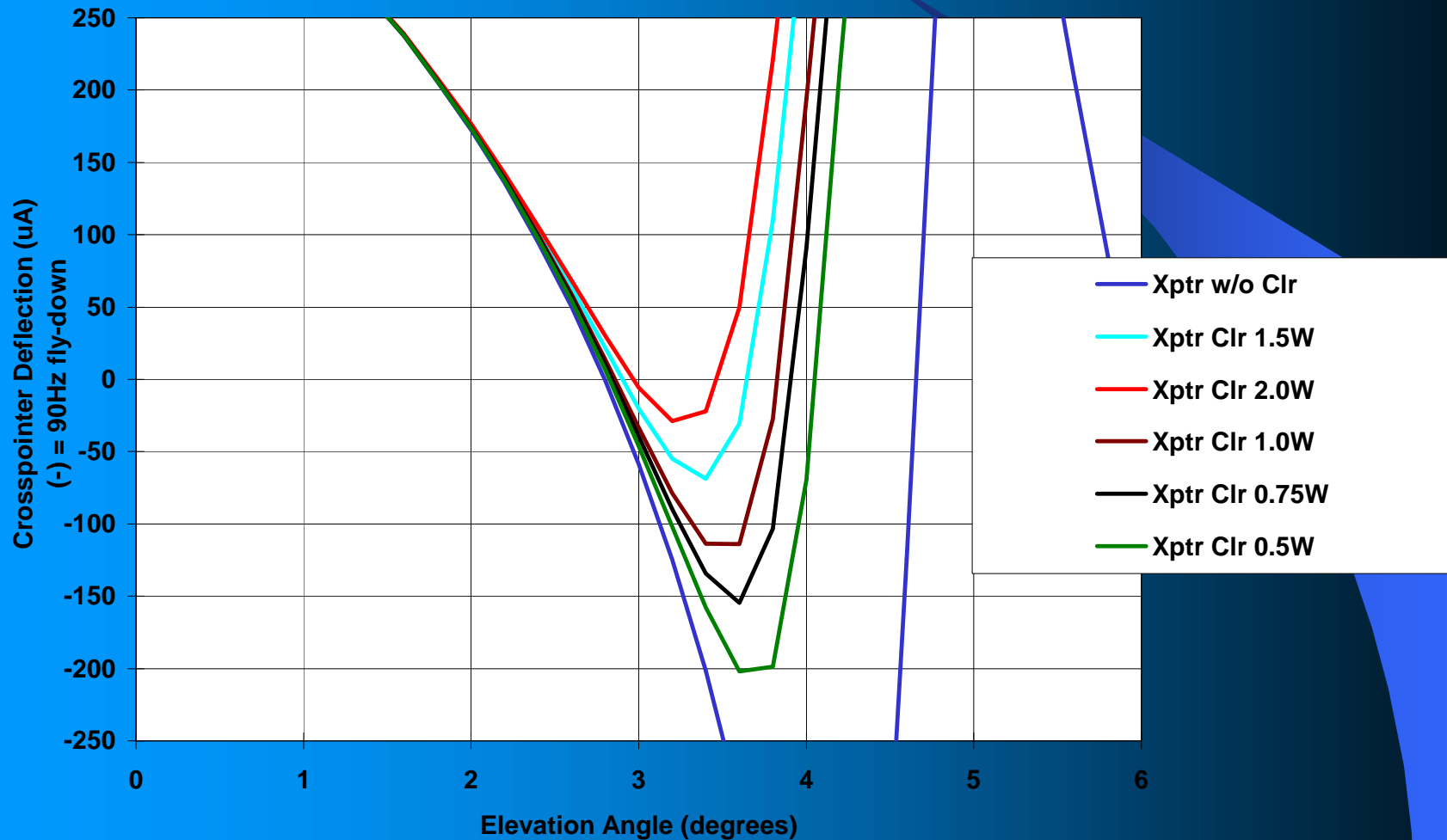


# Loc Reference Errors



# Azimuth Restrictions

Model 106 End Fire Glide Slope System  
ILS 2 "Clearance" Check at 5.0 Degrees Azimuth on the Narrow Side



# Existing Issues

- Does the reference point for the 5 and 8 degree clearance runs require further clarification in 8200.1A?
- Application of BFSL aiming point correction is producing large flares, sometimes out-of-tolerance conditions, near the threshold. Facility is typically in tolerance prior to the correction

# Summary

- Flight inspection time has been reduced on the end-fire glide slope systems
- Further reductions are possible
- Substantial progress has been made in recent years in improving documentation and training
- Repetitive issues will continue to be addressed and ultimately resolved