NYSEARCH

Direct Assessment Activities by NYSEARCH/NGA & NGA

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DOT R & D Forum

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NYSEARCH/NGA Initiatives for Direct Assessment (DA)

- **Phase 1 ECDA Validation Project**
  - March 2002 – April 2003
- **Phase 2 DA Project**
  - April 2003 – September 2004
- **ECDA Criteria Project**
  - June 2004 – mid-2006
- RFP related to Difficult Applications of DA
  - Projects initiated December 2004
- NGA activity related to evolving Industry Standards

Phase I and Phase II Participants

- Nine NYS LDC NGA members participated in Ph I DA Validation Project:
  - KeySpan
  - National Fuel
  - NYS Electric & Gas
  - Niagara Mohawk
  - Rochester Gas & Electric
  - Central Hudson
  - St. Lawrence Gas
  - Consolidated Edison
  - Orange & Rockland
- Twelve LDCs participating in Ph II DA Project:
  - KeySpan
  - National Fuel
  - NYS Electric & Gas
  - Niagara Mohawk
  - Rochester Gas & Electric
  - Questar
  - Central Hudson
  - Enbridge/St. Lawrence Gas
  - Consolidated Edison
  - Orange & Rockland
  - PECO
  - Public Service Electric & Gas
- NY PSC involved from start as active participant

Phase I NYS DA Process Validation Project Objectives

- Demonstrate that ECDA is a valid alternative to ILI and pressure testing
- Prove to NGA-NY members, NYS PSC Staff, and federal regulators that ECDA can be used to assess pipeline integrity with respect to external corrosion, coating flaws and third party damage
- Fill an industry gap for quantitative validation

Key Project Elements

- Consistent with RP0502
- Process applied in a consistent and structured manner across NYS allowing pooling of data
- Industry expert, CC Technologies – objective third party

Phase I DA Process Validation Project

The DA process was validated by:

- Demonstrating that ECDA as performed by NGA -NY companies (and in compliance with the NACE RP0502) discriminates between pipeline locations in good and poor conditions with respect to corrosion and/or coating damage

Phase I Technical Approach

- Nine NGA members performed ECDA on ~ 2 mile segments (total 20 miles)
- Utilized indirect survey tools and selected locations on the pipe predicted to have indications and predicted to have non-indications (controls).
- Excavate ECDA indications and controls and assess condition using 3 separate metrics
  1. Coating damage
  2. Corrosion damage (i.e., metal loss)
  3. Corrosivity (e.g., soil chemistry at pipe surface)
- Compare predictions to actual results
- Perform statistical analysis

Phase II Technical Approach

- Phase II included adding to Phase I validation (total ~60 miles)
- Redo analysis to decrease statistical uncertainties
  - Interpretation of probabilities require consideration of confidence intervals
- Develop understanding and approach for addressing challenging or difficult environments with DA

Project Definitions

- **Indications:** Locations on pipe predicted to have anomalies. (Anomalies=coating flaws, external corrosion, metal loss, third party damage)
- **Controls (non-indications):** Locations on pipe predicted to be in good condition.

Indications and controls selected based on survey data, pre-assessment information and operator knowledge of system

Controls required to conduct statistical analysis

ECDA Validation

- ~60 miles of pipe
- 113 excavations
  - 84 indications
    - 81 locations with coating flaws
      - 18 corrosion damage
      - 3 mechanical damage
  - 29 controls
    - 25 no damage
    - 4 coating flaw

	Indication	Control
Exposed Metal Coating Flaw Only	43	0
Disbonded Coating Only*	7	2
Exposed Metal & Disbonded*	31	2
No Coating Damage	3	25
Total Excavations	84	29

	Indication	Control
Corrosion Damage Only	17	0
Mechanical Damage Only	2	0
Corrosion & Mechanical Damage	1	0
No Metal Damage	64	29
Total Excavations	84	29

Binary Logistic Regression

- P(defect) at indication is 96%
  - P(no defect) is 4%
  - Odds of finding a defect at indication 27 to 1
- P(defect) at control is 14
  - P(no defect) is 86%
  - Odds of finding a defect at a control 1 in 6
- Odds ratio of finding a defect at indication vs. control is 169 to 1

Examples of Validated Data

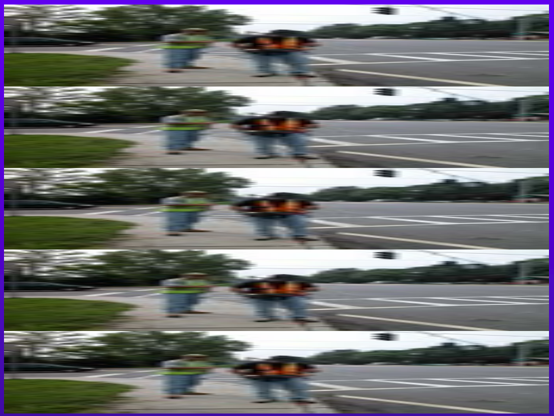
Mechanical damage detected by ECDA and apparently caused during installation of fiber optic cable.

Corrosion damage detected by ECDA.

Phase I Conclusions

- Data collected supports ECDA as a valid integrity management tool
- ECDA on par with ILI and pressure testing
- Improved technical capability by member companies to perform DA
- Elevated NYS PSC understanding of DA

Lessons Learned about DA Implementation



Overall:

- ***DA requires a high attention to detail***
- ***DA requires a thorough engineering analysis and approach***
- ***Communication essential!***

Additional Activities in Phase II

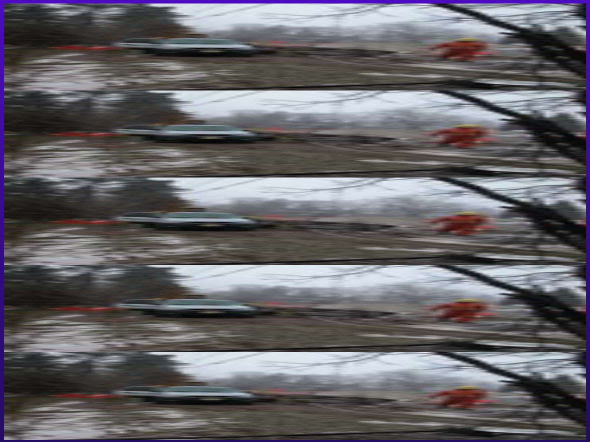
- **Develop consistent DA approaches and protocols for “special areas”**
  - Cased pipe
  - Bare pipe
  - Inaccessible pipe
  - Stray current areas

- **Test new long range guided wave inspection tools**

- **Develop DA Plans for NGA Integrity Management Program**

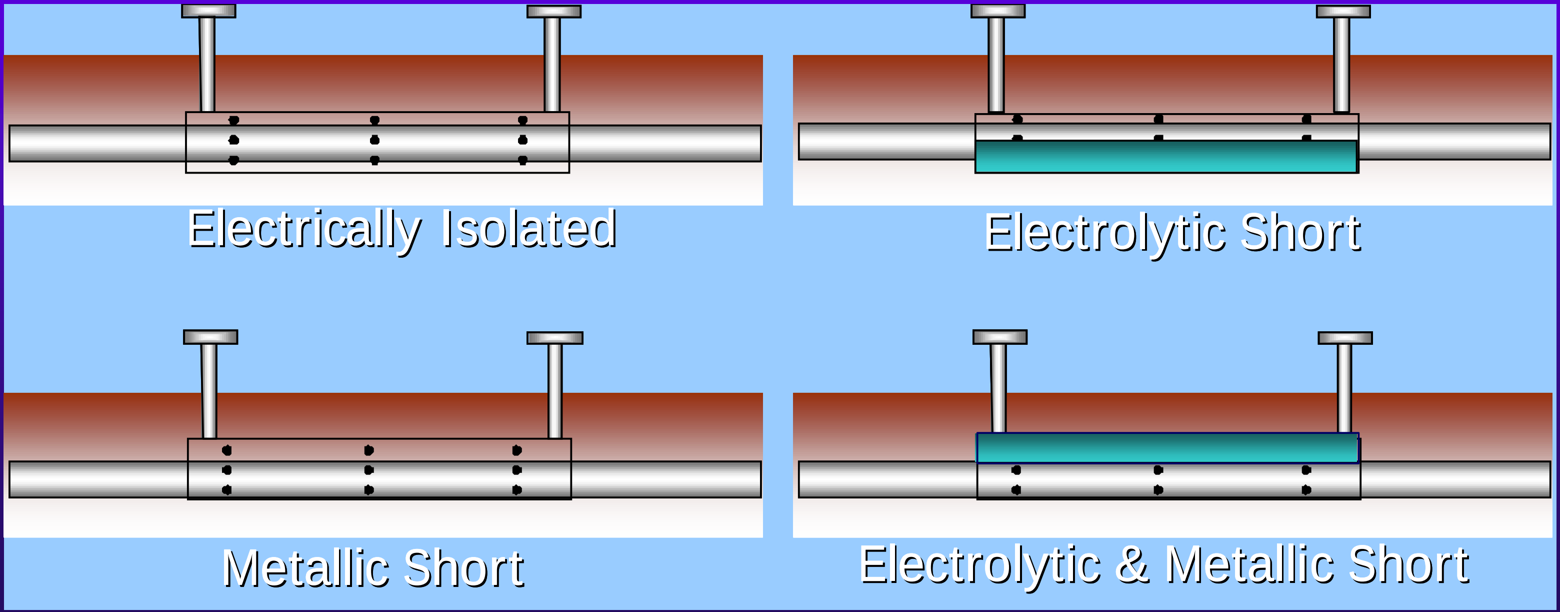
Special Applications of DA

- Stray Current
  - Reduce measurement errors – guideline document
- Uncased crossings
  - Modify conventional ECDA tool application
    - P/S Potential (measurement or calculation)
    - Current Attenuation (macro)
- Cased pipe
  - Focus on mechanism for corrosion susceptibility
  - Prioritize casings likely to have corrosion
- Bare pipe
  - Prioritize corrosivity
  - Consider CIS accuracy



Field Tests and DA to Address Cased Crossings

- Focus on mechanism for corrosion susceptibility
  - Prioritize casings by likelihood of corrosion



DA to Address Bare Pipe

- Coating flaw tools not relevant
- Potential measurement more accurate
- Other prioritization tools for corrosivity
  - Soil Properties (e.g., resistivity)

NGA Work to Finalize DA Plans

- Multiple constraints
  - Detailed specificity (including criteria)
  - Operator flexibility (for customizing)
  - Technical accuracy

- Plans for insertion to IMP*
  - ECDA
  - ICDA
  - SCCDA

*Overall plan developed by Gulf Interstate for NGA

Phase II Conclusions

- Validation further improved
- Protocols developed
  - Inaccessible
    - Straightforward but pipe-specific
  - Stray
    - Issues known
  - Cased
    - Approach good, direct examinations still issue
  - Bare
    - Some success, more to do, work ongoing in industry
- DA Plans developed
  - Living documents

NYSEARCH/NGA ECDA Criteria Development Project

- NYSEARCH/NGA teaming with CC Technologies & University of Florida
- Main objective: Develop an Excel spreadsheet tool which aids the operator in <u>selecting and prioritizing indications</u> (and digs)

Selecting Direct Examinations

How does the operator select where to excavate?

- Survey data (Indirect Inspections)
- Use of Preassessment data
- Operator knowledge of the system
- Expert opinion
- Sound engineering judgment

SUBJECTIVE PROCESS

Selection of Digs

- Subjectivity used to consider site specific parameters and pipeline conditions influence selection
- Problem – Gas Rule requires uniform criteria for prioritization
  - Industry response is to use company specific numerical criteria without consideration for pipeline conditions
    - Too many digs ($$$), or the wrong digs (safety)
- Solution – develop objective pipeline-specific criteria to work ***<u>in conjunction</u>*** with the process used today

Benefits of ECDA Criteria Model

In summary, criteria could help operators:

- Prioritize indications and determine where to dig as this process is often challenging
- Satisfy Pipeline Integrity Rule requirements
- Better defend dig locations (e.g., to regulators)
- Provide increased consistency among the NGA/NYSEARCH members

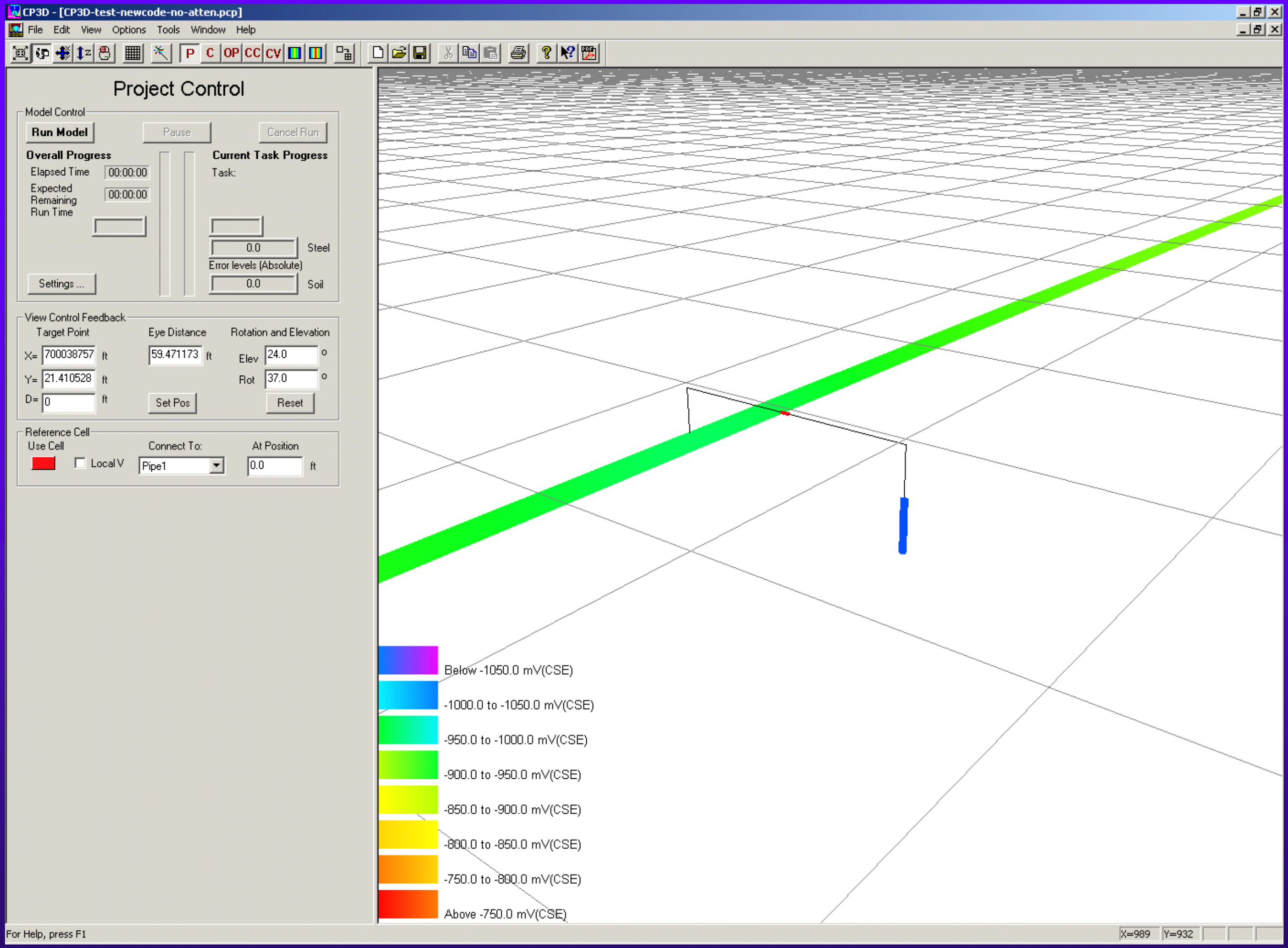
Examples of ECDA Criteria

- CIS Criteria
  - CP effectiveness criteria (i.e., -850mV or 100mV)?
    - What change is significant?
    - Is on/off relevant?
    - What is proper survey spacing?
- DCVG (or ACVG) Criteria
  - %IR and/or mV drop
    - Depends on soil resistivity, pipe defect geometry/size, anode configuration, applied current
- Current Attenuation
  - % attenuation depends on resistivity, polarization level/character, galvanic anodes, etc.

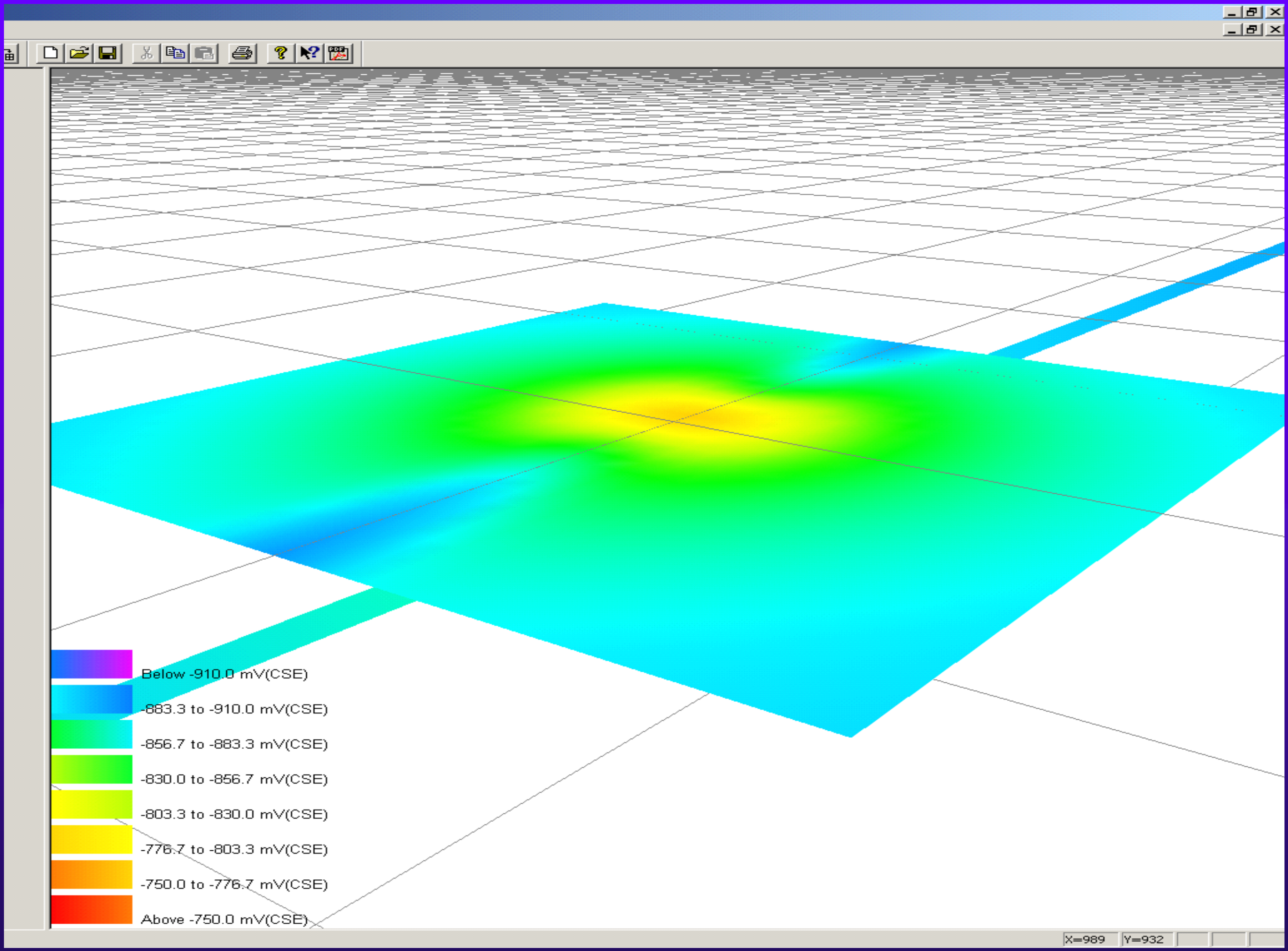
Need Criteria Specific to Pipeline Region

- Most tools relate above ground measurement of current or potential to coating or corrosion condition
  - Based on E and I distribution around pipeline coating flaws and affected by
    - CP level, resistivity, coating condition (including defect interaction), polarizability, galvanic anodes, depth of cover, Pipe OD.
- Use CP predictive models
- A bonus: technical basis for survey spacing

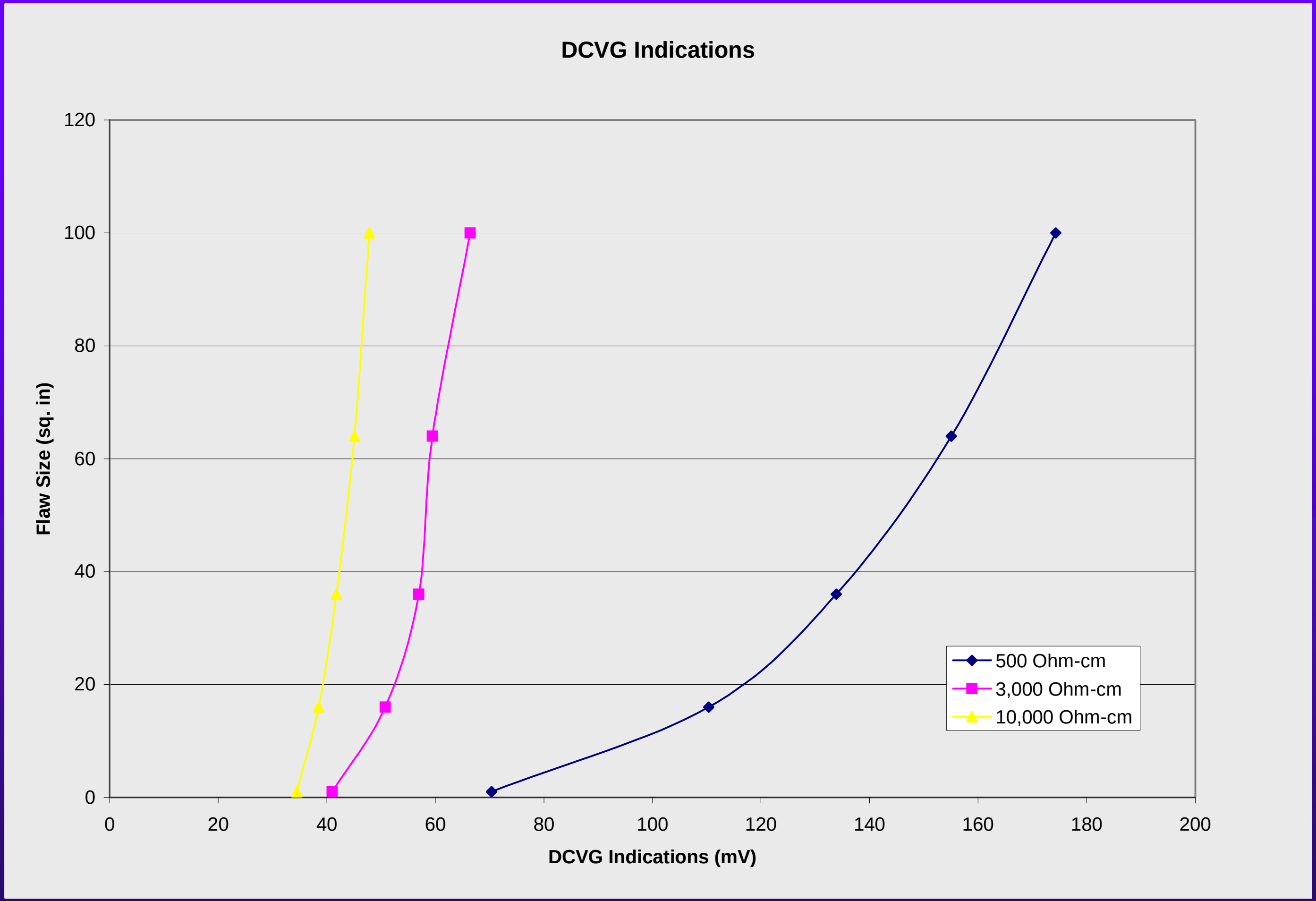
Single Mg Anode



Off Potential with Coating Flaw



ECDA Criteria Modeling Sample Output



NYSEARCH/NGA Projects to Address Special Applications of DA

- TWI/FBS Long Range Guided Ultrasonic Inspection Technology
- SwRI – Development of Long Term Monitor Using MagnetoStrictive (MsS) Sensor
- FINO AG – NoPig Inspection Technology
- CCT – Enhanced Voltmeter to Address High Impedance Areas

- Design, Installation and Operation of Utility-Specific Underground Test Bed (2005)
  - Testing funded and new approaches
  - Using for DA training and new technology evaluation

Current Thinking on Potential Gaps & Challenges

- Need to further develop quantitative bases for ECDA decisions
- Need to customize ECDA for specific pipeline regions
- Need to study root causes of corrosion
- Need to improve interpretation of indirect inspection survey data
- Gaps exist for pieces of special ECDA areas: station piping, multiple pipes in ROW, etc.

Overall Summary

- ECDA process working well
  - Validated on pipes typical of most systems
- Procedures are necessary for special applications within a segment
- DA plans for IMPs are in place
- Custom ECDA criteria being developed
- Members stepping up activities on ICDA
- Technologies to address special applications are being developed but gaps still exist