



A BNFL Group company

New CHF Correlations for Westinghouse PWR Fuel

Pre-Submittal Meeting at
USNRC One White Flint

April, 2005

Agenda

- Objectives of Meeting
- NGF Correlation
 - Need for CHF Correlation for NGF Fuel Designs
 - Grid Mixing Vane Designs Covered by Correlation
 - Database Range Used to Develop and Verify Correlation
 - CHF Correlation Form
 - CHF Correlation Statistical Tests
 - Licensing Submittal
 - Schedule
- ABB-NV Qualification for W-3 Replacement
 - ABB-NV DNB Correlation
 - Current W-3 Applications
 - Planned Licensing Submittal
 - Qualification Approach
 - Proposed Report Outline & Schedule
 - Summary

Meeting Objective

- Present summary of the new CHF correlation for Westinghouse Next Generation Fuel (WNGF) for PWRs
- Present summary for W-3 replacement correlation for non-mixing grid region for Westinghouse PWRs
- Present proposed schedule for Westinghouse topical submittals and NRC approval
 - New CHF correlation topical for NGF fuel designs
 - Topical addendum for qualification of ABB-NV for W-3 replacement
- Obtain NRC feedback for new NGF CHF topical report and ABB-NV Qualification for W-3 replacement

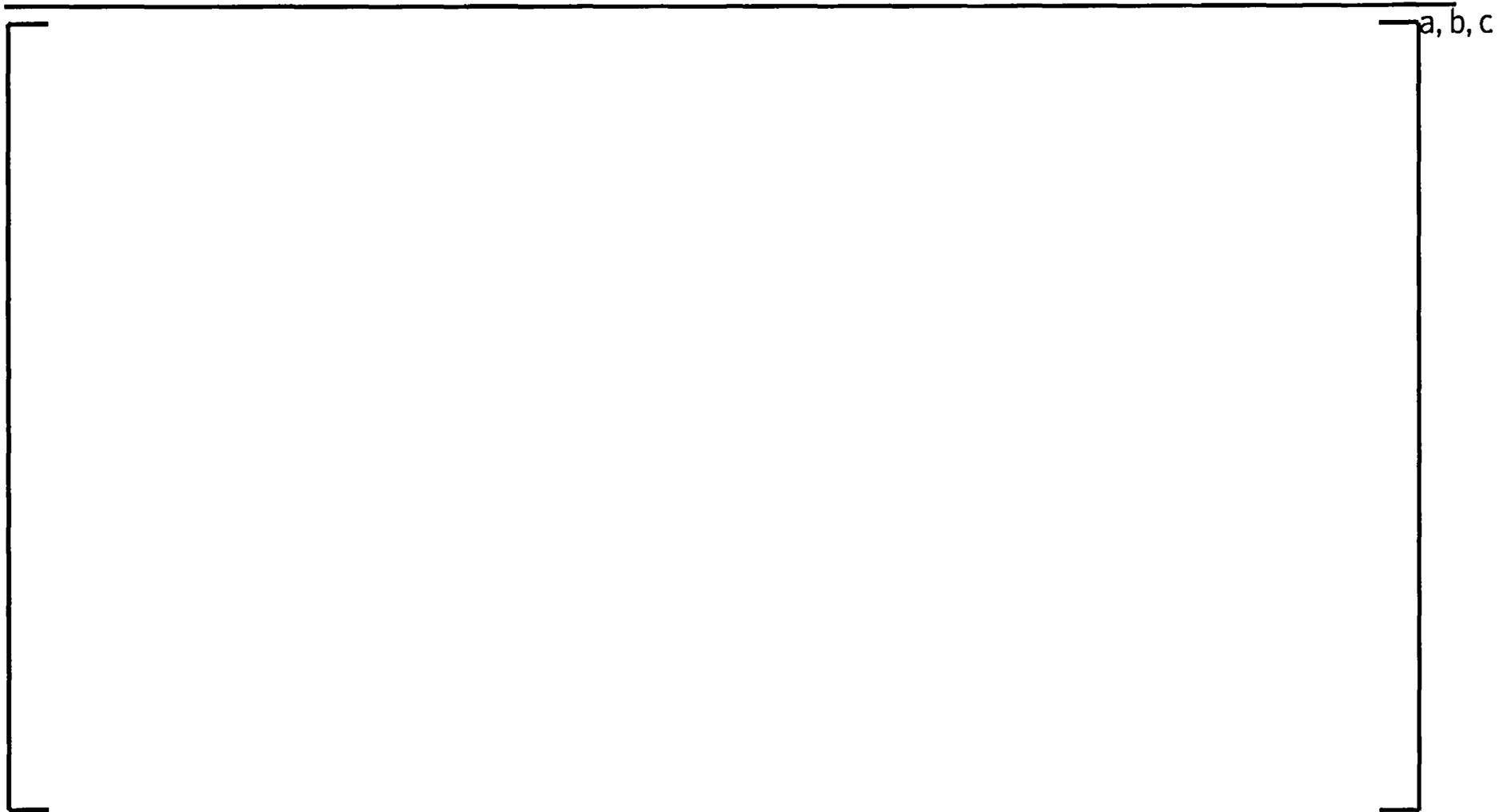
NGF Correlation

Need For New Correlation



- DNB test data collected from Columbia University testing loop

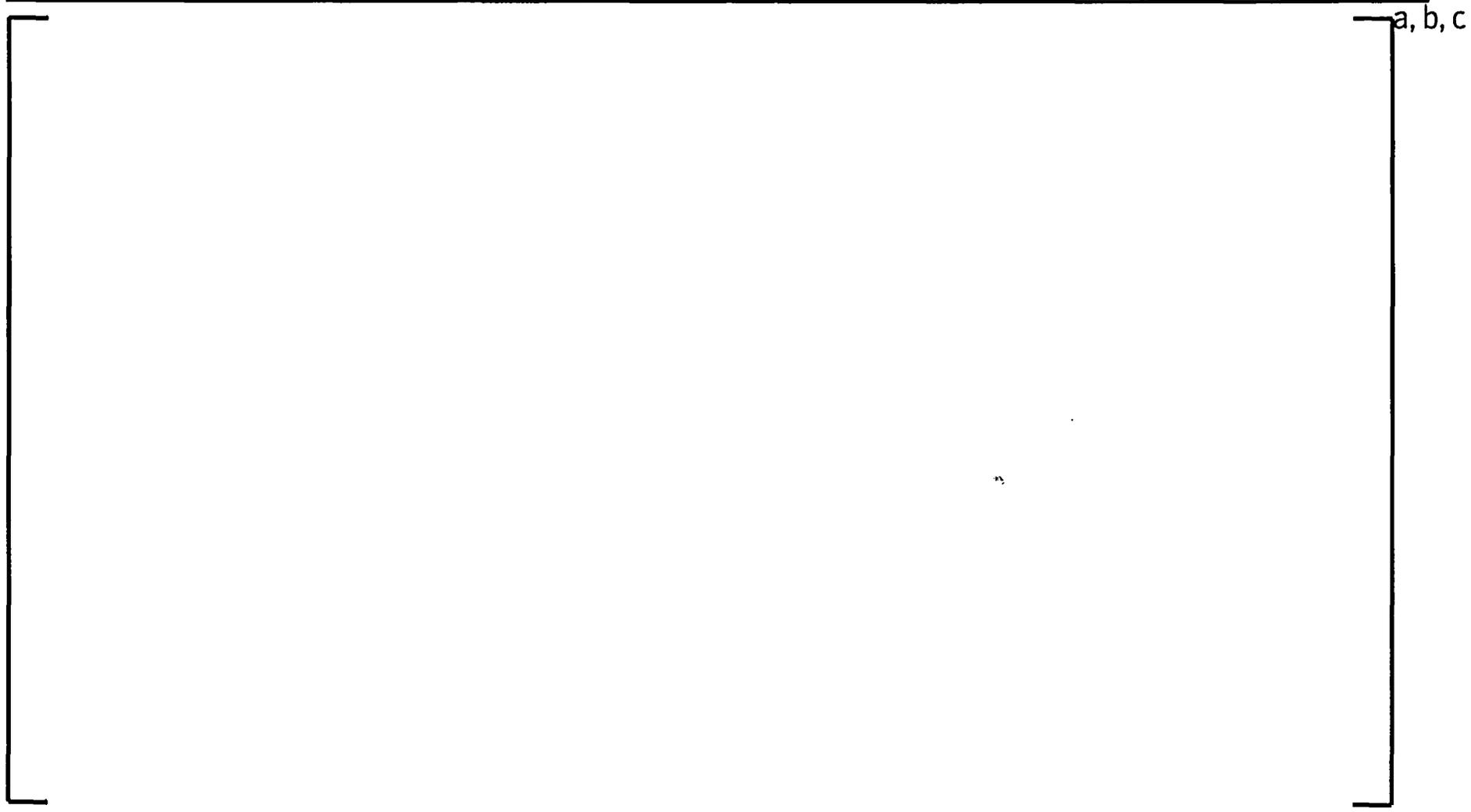
Description of Different Vane Designs



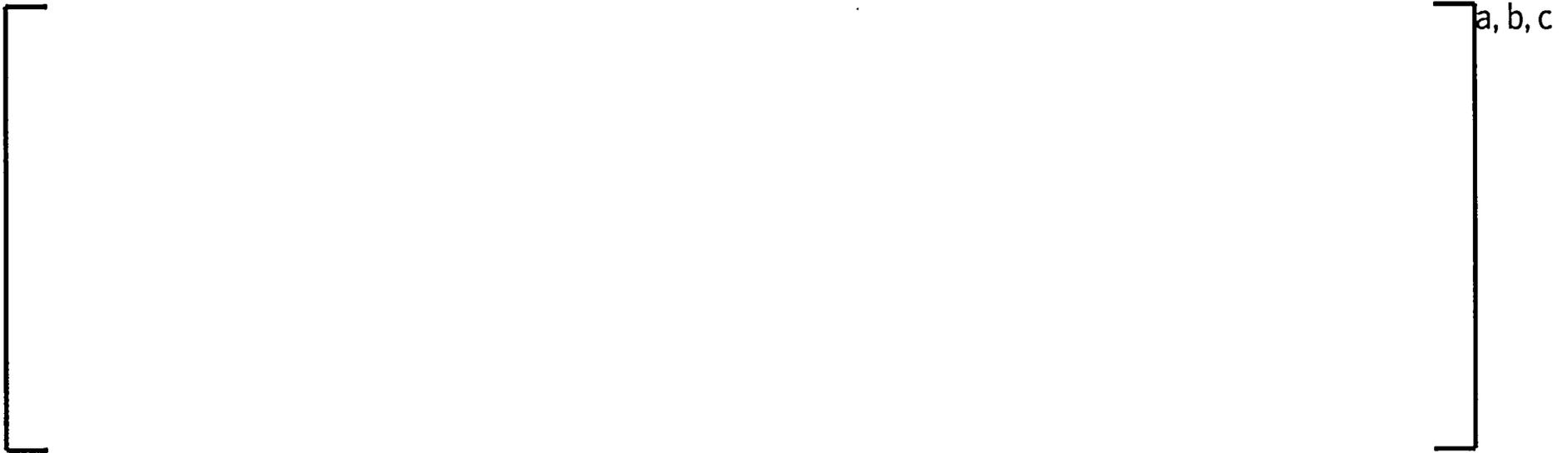
WNGF – Split Vane Correlation Database



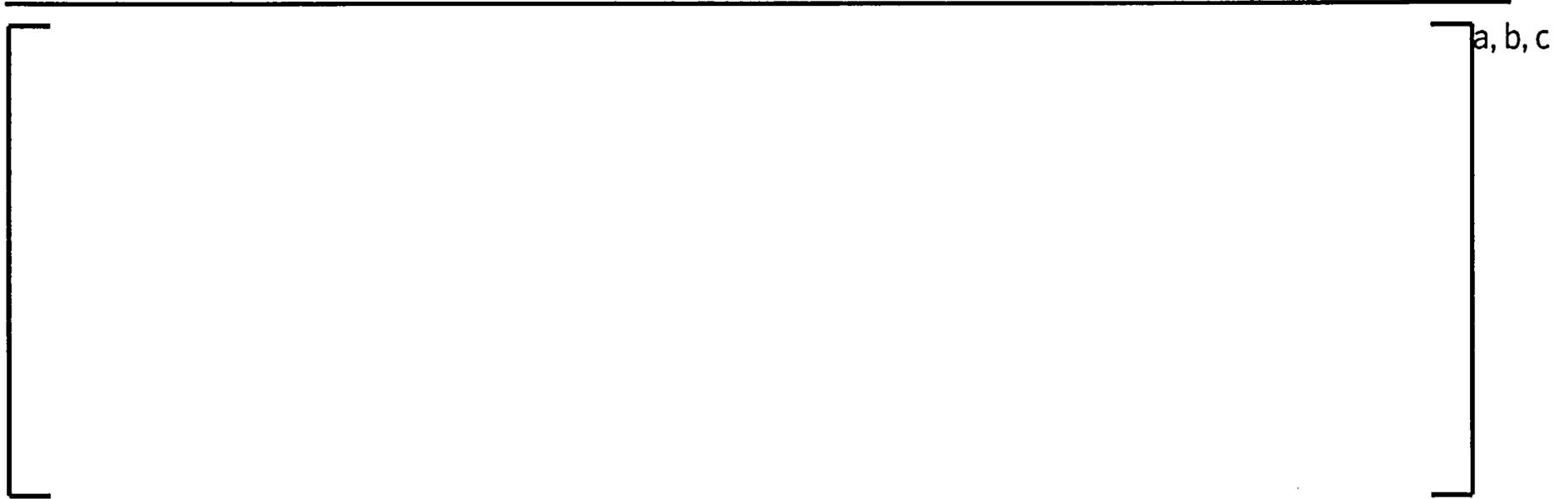
Test Geometries Included in Correlation Development for Split-Vane



Preliminary WNGF-SPV Range of Applicability



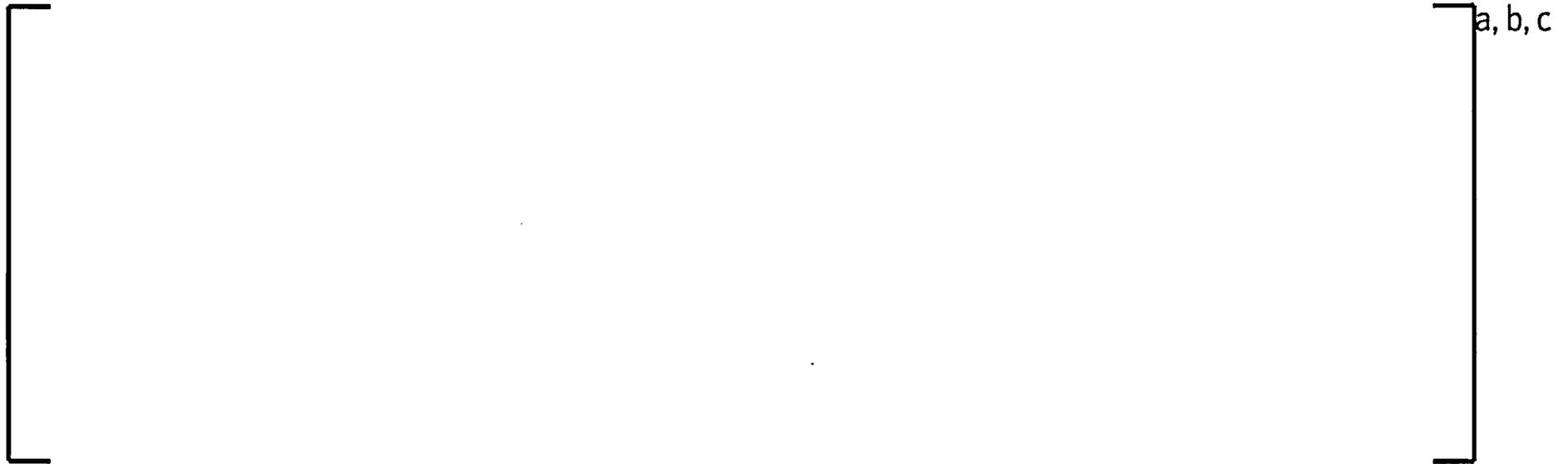
WNGF – Side Supported Vane Correlation Database



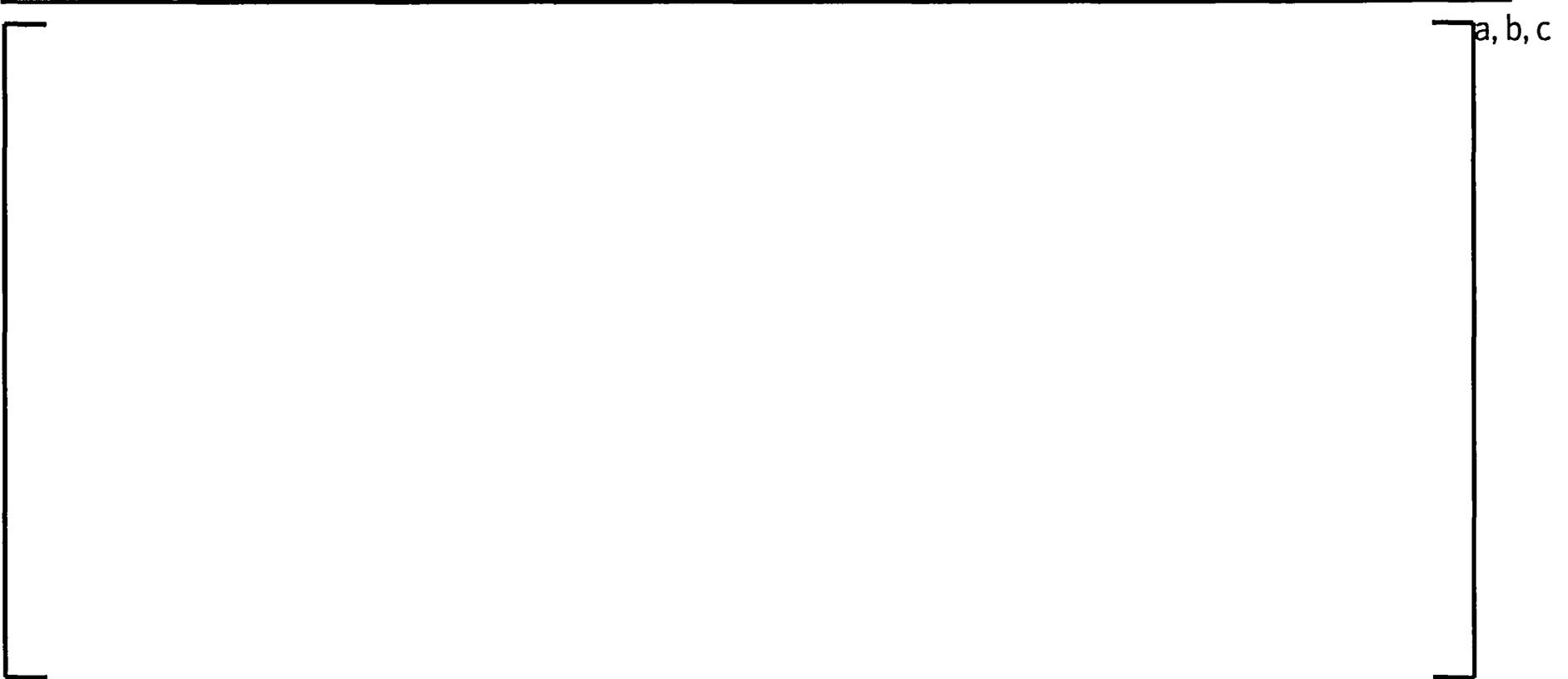
Test Geometries Included in Correlation Development for Side-Supported Vane



Preliminary WNGF-SSV Range of Applicability

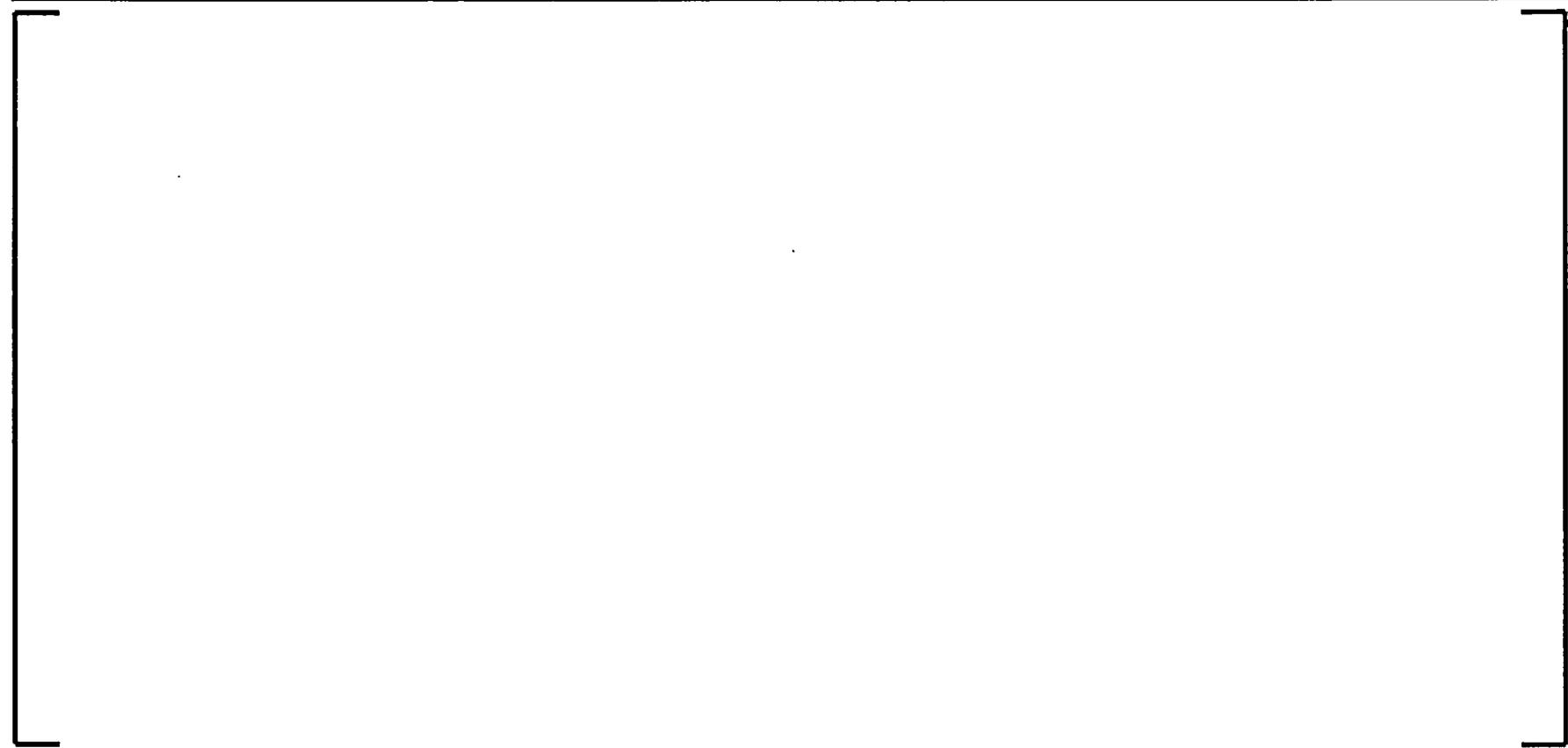


Description of WNGF CHF Correlation



CHF Database Applied to Determine Form for Geometric Terms

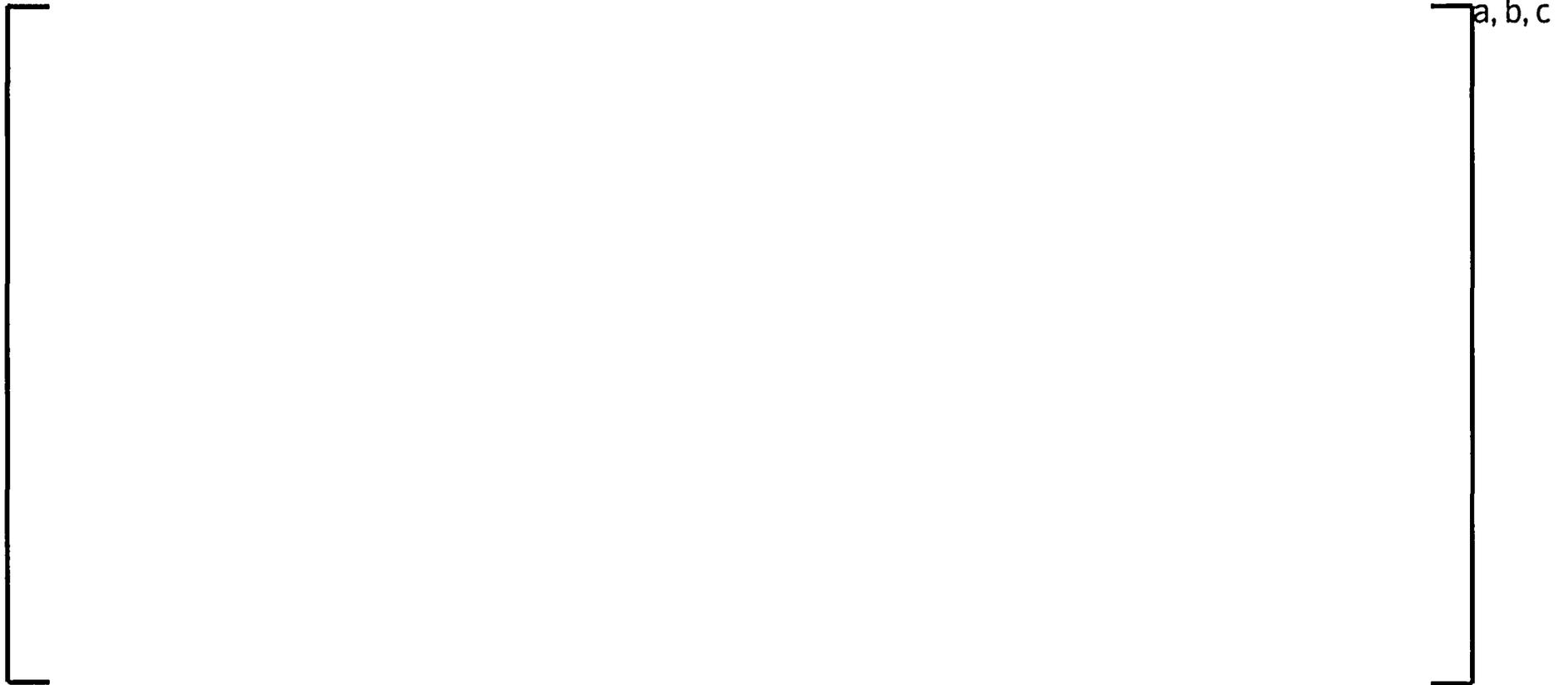
a, b, c



WNGF Correlation Form

[] a, b, c

Determination of Coefficients for WNGF Correlations



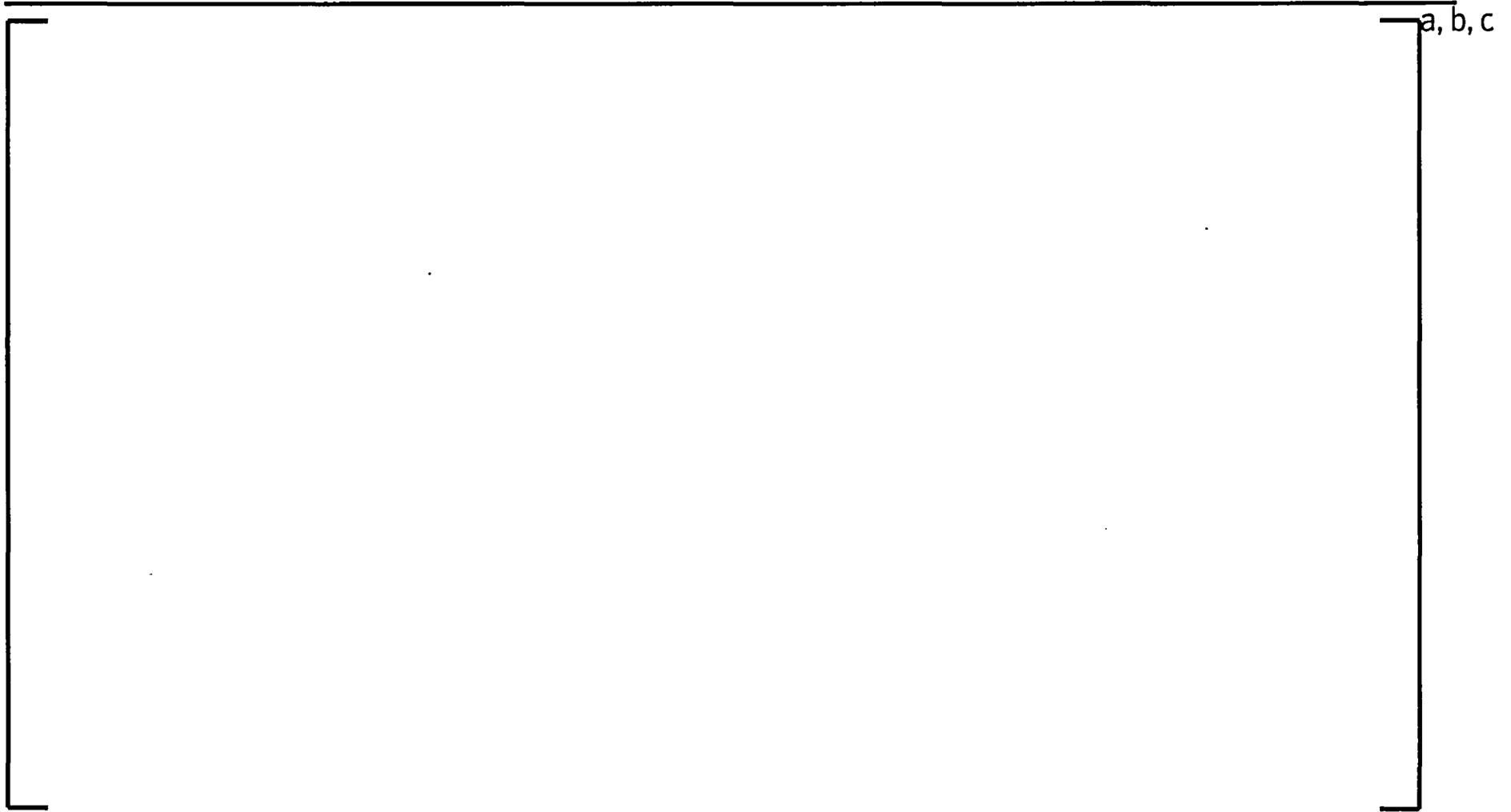
Mixing Data and Measured TDC



Grid Spacing Term



Description of Tong-F Factor



Methodology to Optimize Tong-F Factor

a, b, c

CHF Correlation Statistical Tests

- Statistical testing methods remain unchanged from CENPD-387-P-A
- Resultant correlation and validation databases are examined for outliers and outliers dropped (less than 0.2%)
- Trend plots generated for each variable in correlation to determine trends or regions of non-conservatism
- Normality tests performed on correlation database and validation database; individual tests and grouped data (Normality tests performed with NRC approved D' test)
- For groups that pass normality test, homogeneity of variance test is performed

CHF Correlation Statistical Tests

- Homogeneity of means test is performed on correlation database and validation database to evaluate poolability
 - Geometry
 - Test bundles
- Non-parametric tests are performed to evaluate poolability on data that don't pass normality and/or homogeneity of variance tests
- One-sided 95/95 DNBR limit determined on data set(s) that are shown to be from same population
- All statistical tests employed are standard statistical tests previously used in approved CHF correlation topical reports

WNGF CHF Correlation Topical

a, b, c

Outline of WNGF Topical Report



Schedule

	a, c
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ABB-NV Qualification for W-3 Replacement

ABB-NV DNB Correlation

- Developed based on test data from rod bundles with non-mixing vane (NMV or NV) grids
 - With TORC (CENPD-387-P-A, 2000)
 - With VIPRE (WCAP-14565-P-A Addendum 1-A, 2004)
- Database consists of more 700 points
 - Typical (Matrix) and thimble test bundles
 - Different axial power distributions
- Applicable range defined in SERs
- 95/95 DNBR limit of 1.13 for CE-PWR fuel designs

W-3 DNB Correlation

- Developed in 1960's based on test data from single tube and annular geometry
- Validated to be conservative for rod bundles
 - Cold wall and nonuniform axial power factors
 - Grid benefit not credited
- Used with THINC, VIPRE and other subchannel codes
- Relatively high 95/95 DNBR limits
 - 1.30 (1000 – 2400 psia)
 - 1.45 (500 – 1000 psia)

Current W-3 Applications



Planned Licensing Submittal



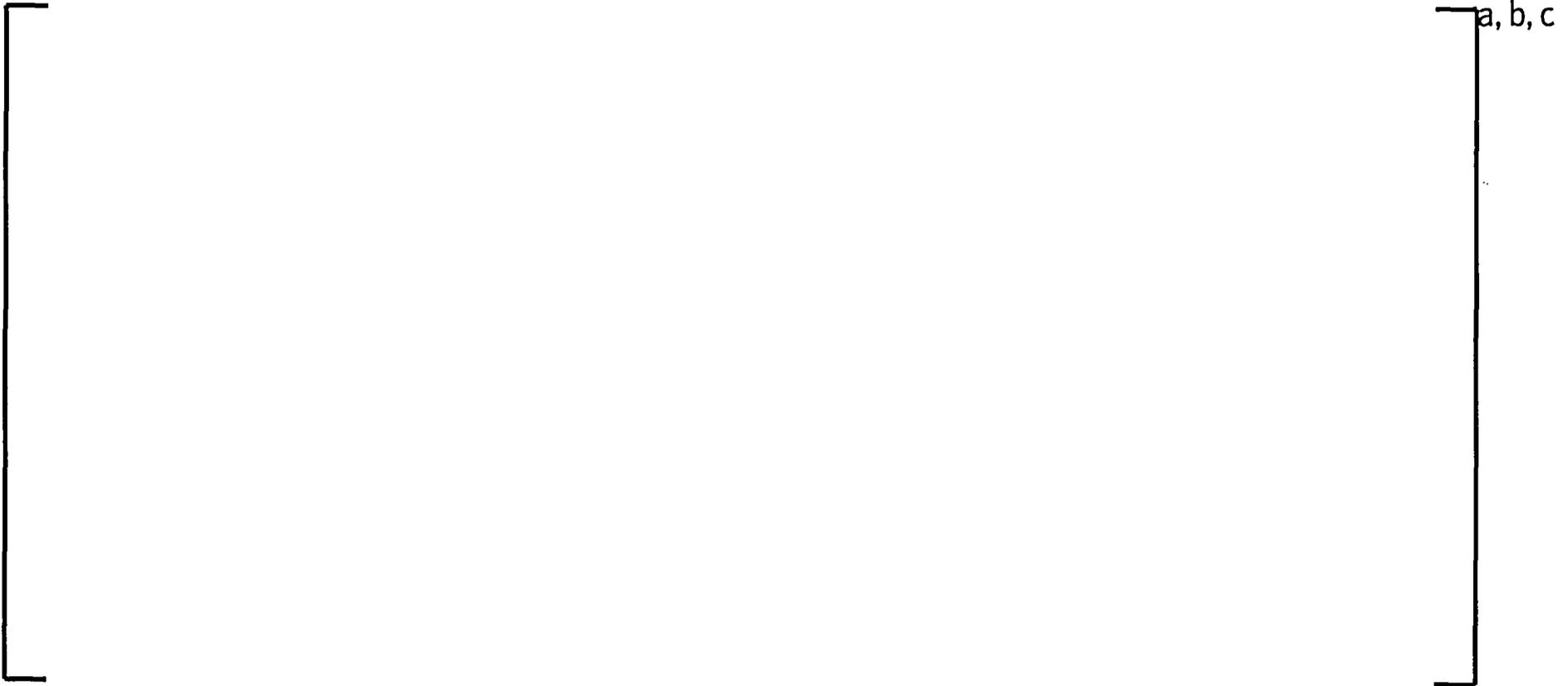
What Will NOT Change



What Will NOT Change

[] a, c

Qualification Approach - Database



Qualification Approach - Database

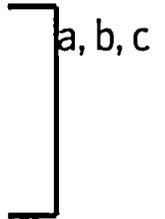


Preliminary Results: ABB-NV Extension



Preliminary Results – ABB-NV Modification

- Compared with test data, ABB-NV correlation needs to be modified for low pressure/low flow/high quality conditions



- Correlation modification is in progress

Outline of W-3 Replacement Submittal



Schedule for W-3 Replacement



W-3 Replacement - Summary





Westinghouse

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