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CC&G
A New Approach to the Validation of Risk Models

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1) Introduction
2) The Model Validation Tool (MoVE)
3) Model Benchmarking
4) 2016 Stress Test Objective

Model Validation: Regulatory Background

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- As part of the focus on CCPs in the wake of the Lehman's Default, European and Worldwide Financial Authorities have requested CCPs to include a **Model Validation Framework** in their Risk Management processes:

  1) **EMIR**, Article 49 (1) (Review of models, stress testing and back testing)
  2) **ESMA**, Section 1 (Models and Programmes), Article 47 (1) (Model Validation)
  3) **CPSS-IOSCO** Recommendations Principles (3.2.16)

- **Model Validation** is a key **Model Risk Mitigant**, i.e. reduces the risk that a model:
  - is not providing accurate output
  - is being used inappropriately

"Remember that all models are wrong; The practical question is how wrong do they have to be to not be useful?"

George Box, from *Empirical Model-Building and Response Surfaces*, 1987"

Model Validation: CC&G Framework

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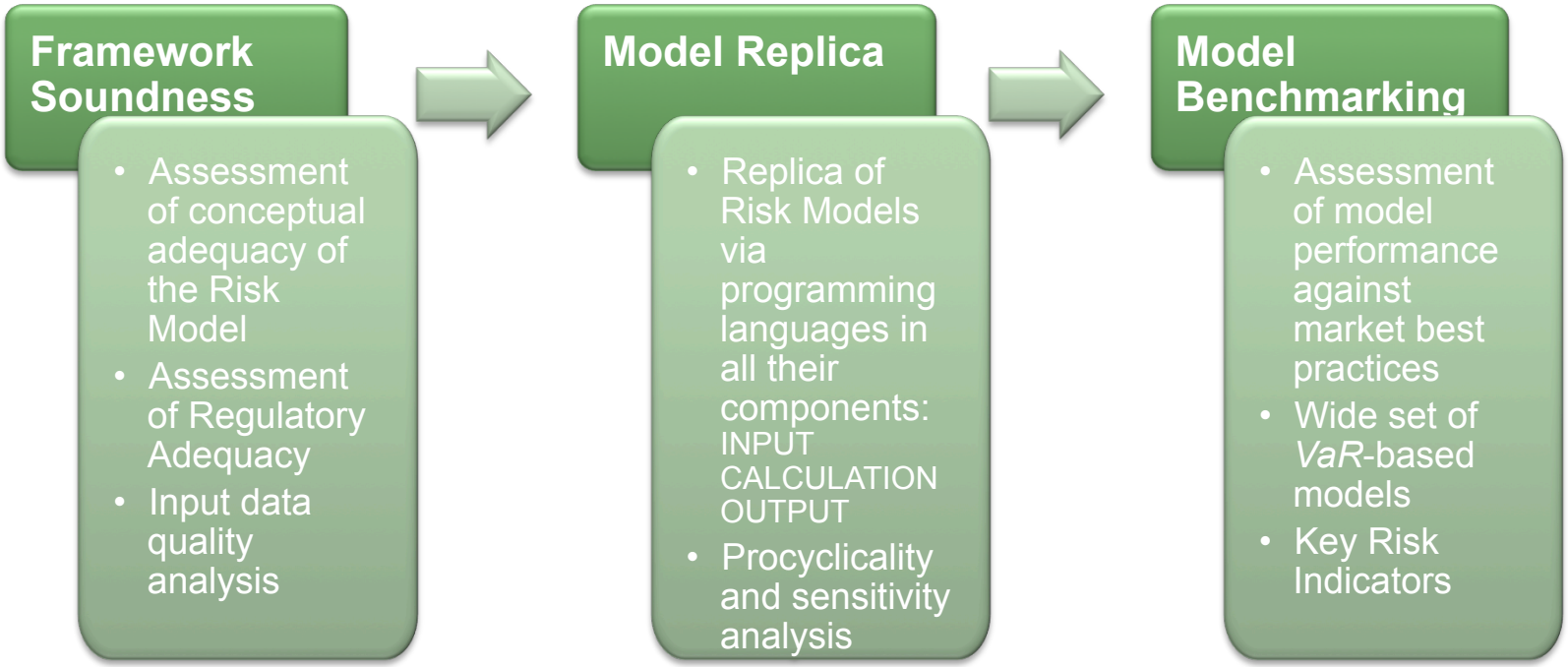
- CC&G has set up a dedicated office to perform an independent analysis of all the components of Risk Models, in compliance with regulatory requirements
- **A <u>web-based tool</u>** has been developed to allow the
  - **replica of the existing risk methodologies** on the main asset classes
  - **performance analysis** through a wide set of **Benchmark Models**
- **<u>Benchmark Models</u>** help to evaluate models performance with market best practices
  - **comparison with CC&G's peers**
  - **strategic decision facilitator**
- Risk Models are ranked in terms of relevance and complexity to ensure that the actual validation process is coherently prioritized:
  - core models validated first ***(Priority Principle)***
  - effort dedicated is proportionate to significance ***(Efficiency Principle)***
- CC&G Model Validation is based on **<u>quantitative analysis</u>** rather than on qualitative grounds

The Model Validation Process



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The Model Validation Tool

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- CC&G Internal Model Validation:
  - is based on a configurable web-based graphical interface ***(MoVE)***
  - allows for a full recalculation of risk algorithms
  - creates a parallel environment for risk calculations

Calculation Engine

- Risk models are developed in Matlab
- More than eight risk models developed for Fixed Income and Cash / Equity Derivatives asset classes
- Possibility to add new ad-hoc models

Web-based Interface

- End users run models through a web-based interface
- Output results available as spreadsheets and charts

Development Kit

- Power users can easily integrate new models in the interface through a dedicated backend

MoVE Web Interface - Input

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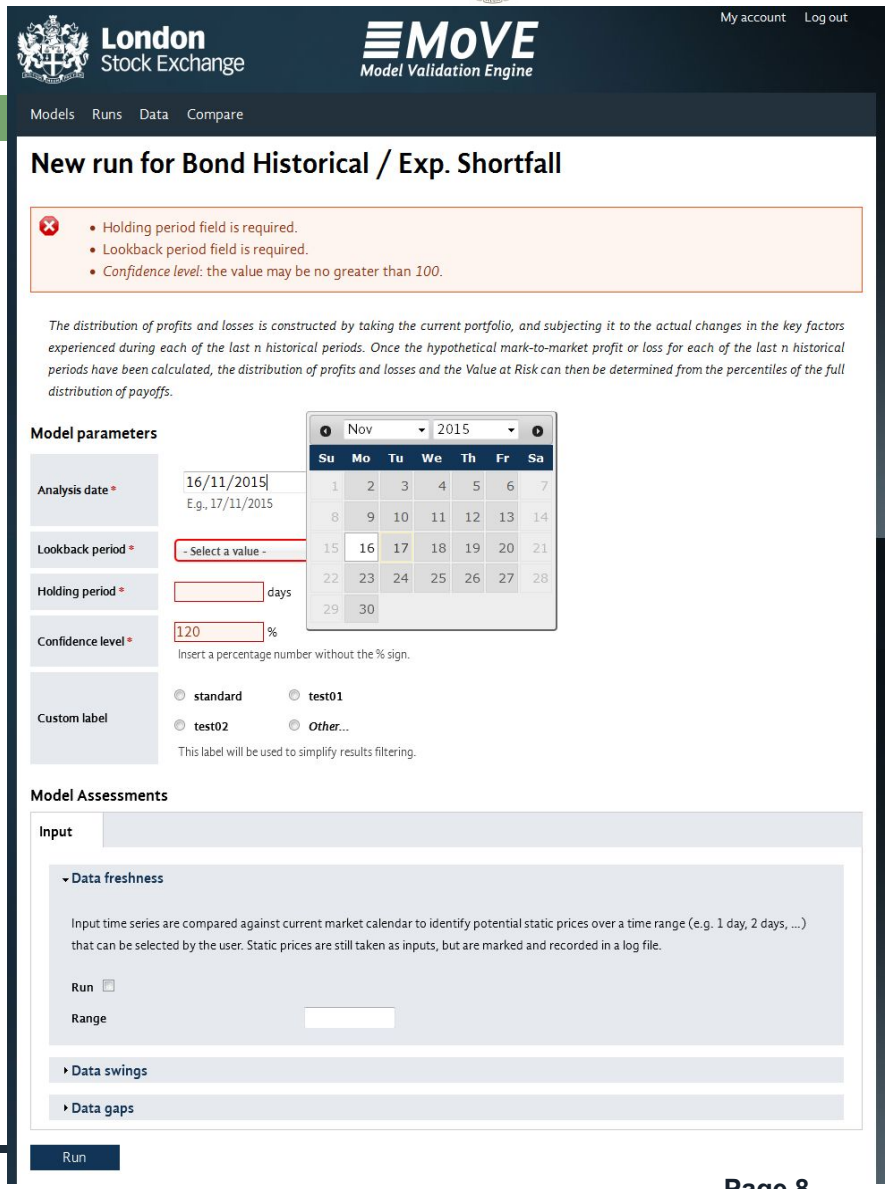
- Batched execution or manual run of models
- Input parameters automatic validation
- Model parameters customizable at every run
- Option to run additional checks on input data
- Model input data automatically retrieved from database
- Option to upload data via input files



MoVE Web Interface - Output

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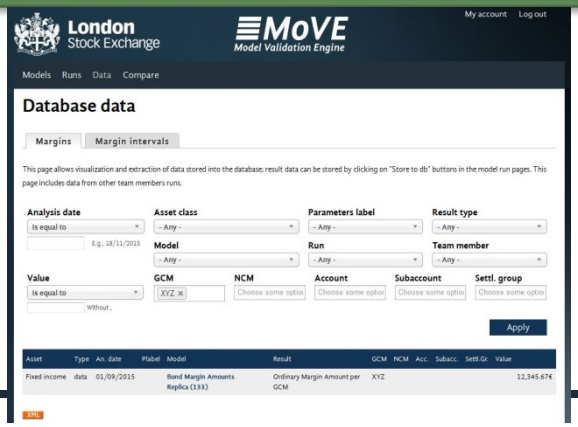
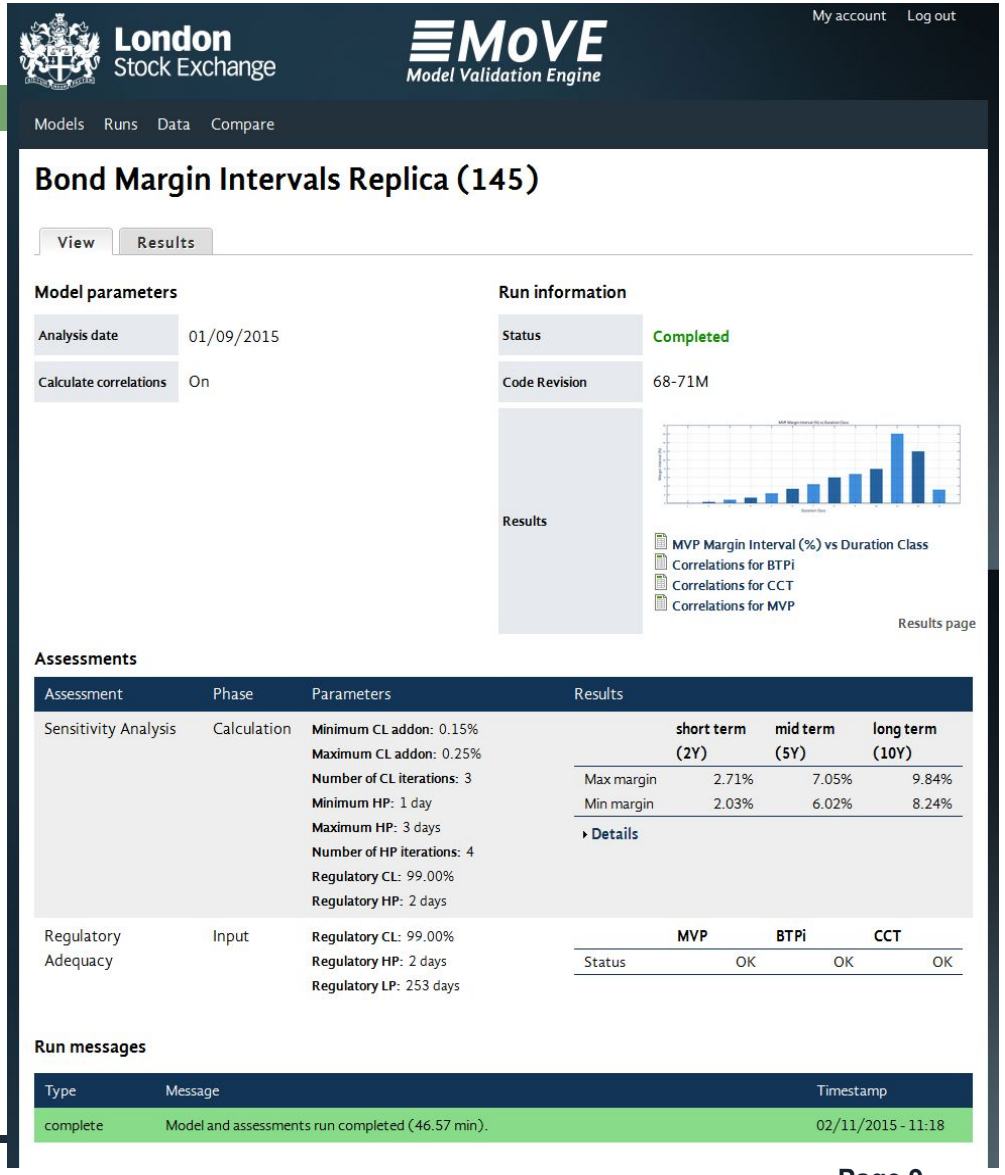
- Model results available as table, dynamic chart or .xls file
- Comparison of different models or same model with different parameters
- Results data storable in database
- User friendly interface for database data extraction





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Model Benchmarking

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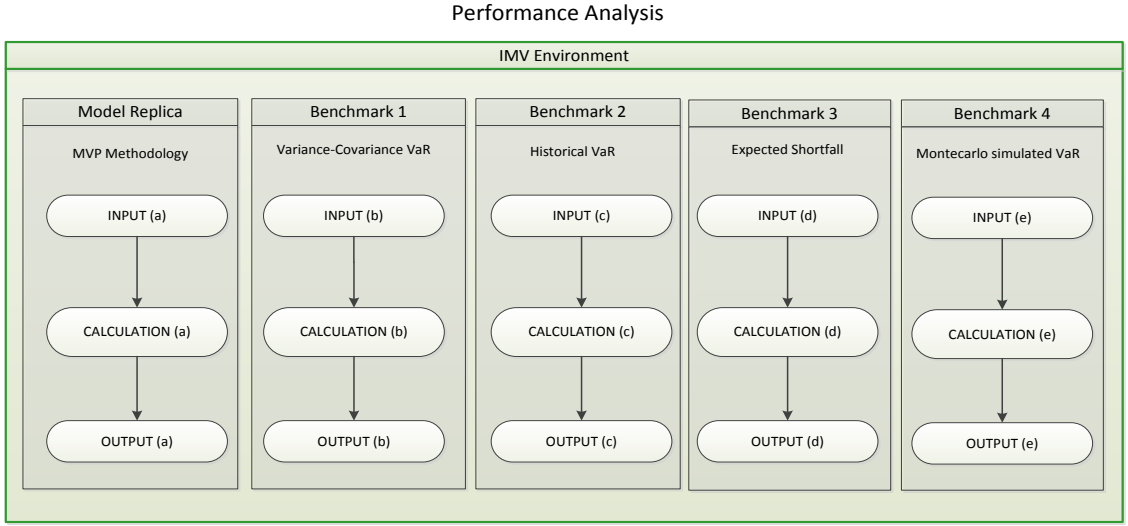
- **Four *Value at Risk (VaR)* Benchmark Models** have been implemented for both Fixed Income and Equities/Equity Derivatives asset classes:
  1) **Parametric VaR**
  2) **Historical VaR**
  3) **Expected Shortfall**
  4) **Monte Carlo Simulated VaR**
- The web-based tool allows to run both the model replica and each benchmark model



Benchmark Models Description

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Name	Variance-Covariance	Historical	Expected Shortfall	Monte Carlo
Description	For each portfolio, determines the amount of potential loss (VaR) that can occur with probability 1-CL over HP days	For each portfolio, determines the amount of potential loss (VaR) that can occur with probability 1-CL over HP days, by ranking historical returns from lowest to highest	Given a quantile-level q, calculates the expected loss of the portfolio given that a loss is occurring at or below the q-quantile	Estimates VaR by simulating random scenarios, revaluing instruments in the portfolio and selecting the CL-percentile of simulated values
What's inside	**Cash-flow mapping:** Map every instrument (principal and coupon amounts) of the portfolio in the appropriate nodes based on Duration **VaR calculation:** Given the present value of x of the future cash payments and the portfolio variance-covariance matrix Σ, $VaR = \alpha\sqrt{x'\Sigma x}$, where α is the normal distribution quantile	All yield input data are converted into prices p For each node j=1,...,n and t=1,...,m day of the time series, given the current price p_{curr}, the following price variations are computed $p^j_{curr}\frac{p^j_t}{p^j_{t-hp}}$ ○The portfolio is fully re-evaluated by multiplying the notional amount allocated to each node by the related price scenario and then selecting the CL-percentile	Same assumptions as Historical VaR Given the loss function X, ES is given by: $E(X \mid X < q) = \frac{\int_{-\infty}^{q} xf(x)dx}{\int_{-\infty}^{q} f(x)dx}$	1) Select a stochastic process for yields: $y\downarrow t = f(t) + \varepsilon\downarrow t$ 2) Compute yields at T+1 for N_{sim} times (Nelson Siegel Model) 3) VaR is the CL-percentile of the N_{sim} portfolio value variations
Advantage	• Fast and simple to calculate • Needs only correlations of risk factors as input	• No assumptions on distribution	• More conservative than Historical VaR • Coherent risk measure	• Converges to the solution • Future can behave differently from the past
Disadvantage	• Normality assumption on portfolio returns	• No distribution to help determine future returns • Assumes future will behave like the past	• No distribution to help determine future returns • Assumes future will behave like the past	• High computational effort • Needed calibration of parameters

Performance Analysis Results

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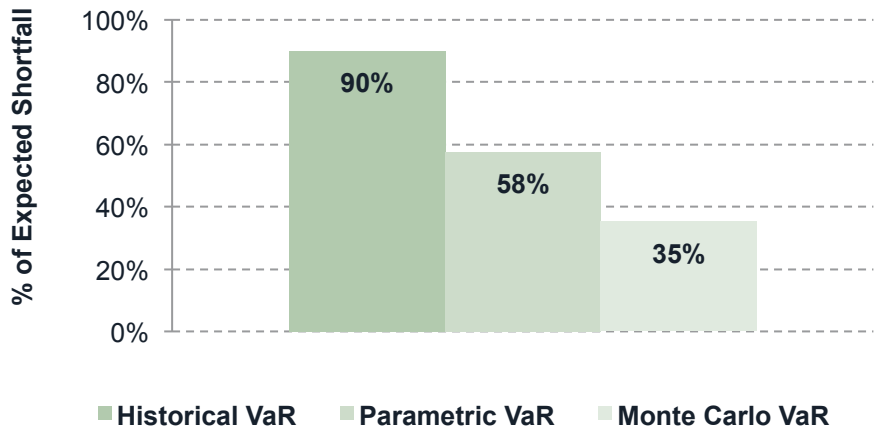
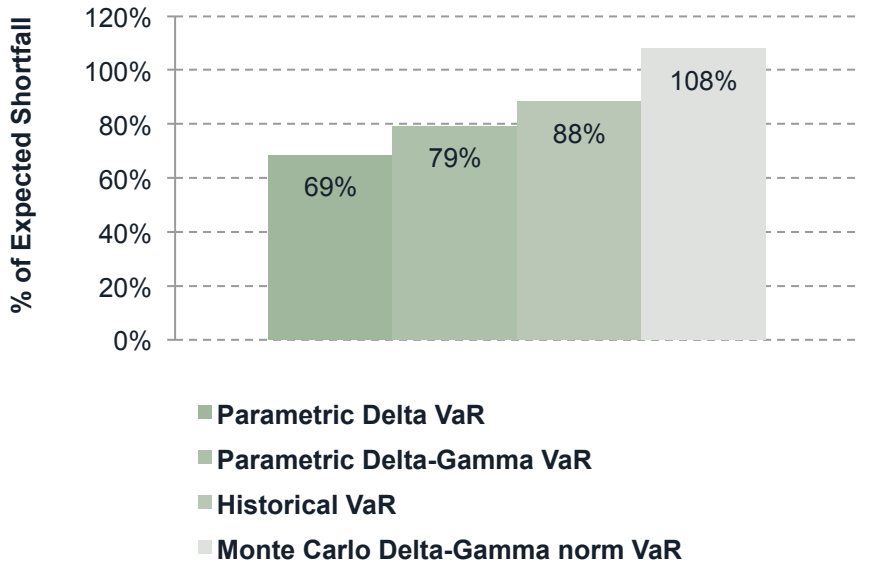
Fixed Income Benchmark Models



Equities & Derivatives Benchmark Models



Conclusions

The Model Validation Software can allow CC&G to:

- Compare its positioning with its competitors
- Perform a procyclicality assessment of different margining models
- Anticipate market trends in CCP Risk Management
- Create the «ecosystem» for excellence in new Risk Models for different asset classes
- Decide whether the risk models applied need to be re-discussed

By the way: incidentally we also happen to fulfil the regulatory requirement of validating our risk models!

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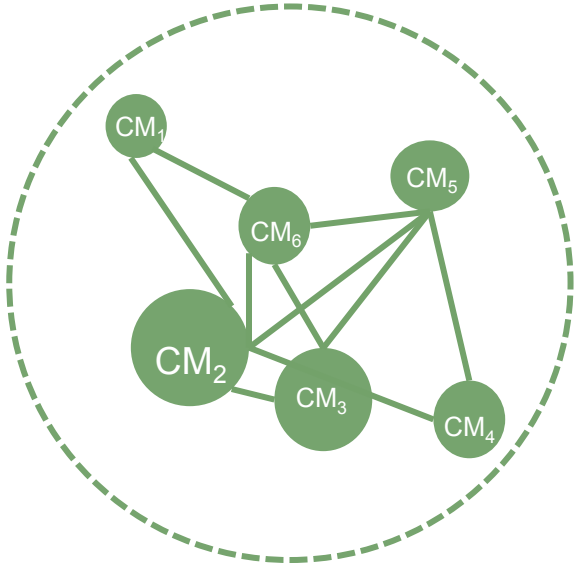
2016 Stress Test Objective

- Best practices for CCPs stress tests are still under discussion
  - ESMA has initiated and coordinated the first EU-wide stress exercise that assessed the resilience of 17 CCPs
  - CC&G is looking at some **innovative stress test methodologies** which could integrate the existing methodology
  - A collaboration with ***Institute for Complex Systems*** **(ISC-CNR)** has started on this topic

DebtRank Network

- The innovation could lie in combining together **credit and liquidity risk** and **stressed scenarios** through a **network-based model of intebank markets**
- Network-based models aim at describing mutual impacts among Clearing Members (CMs)
- Links between Clearing Members show their inter-dependency and the ways a shock could propagate in the financial system
- Systemic risk is measured by potential losses within the financial network after reverberation of shocks



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