Generator Performance Analysis Report

MISO Market

Analysis Date: 2025-08-12

This report provides a comprehensive analysis of generator forecast performance, including performance classifications, anomaly detection, chronic error patterns, and bid validation results. The analysis identifies generators requiring attention and provides actionable recommendations for improvement.
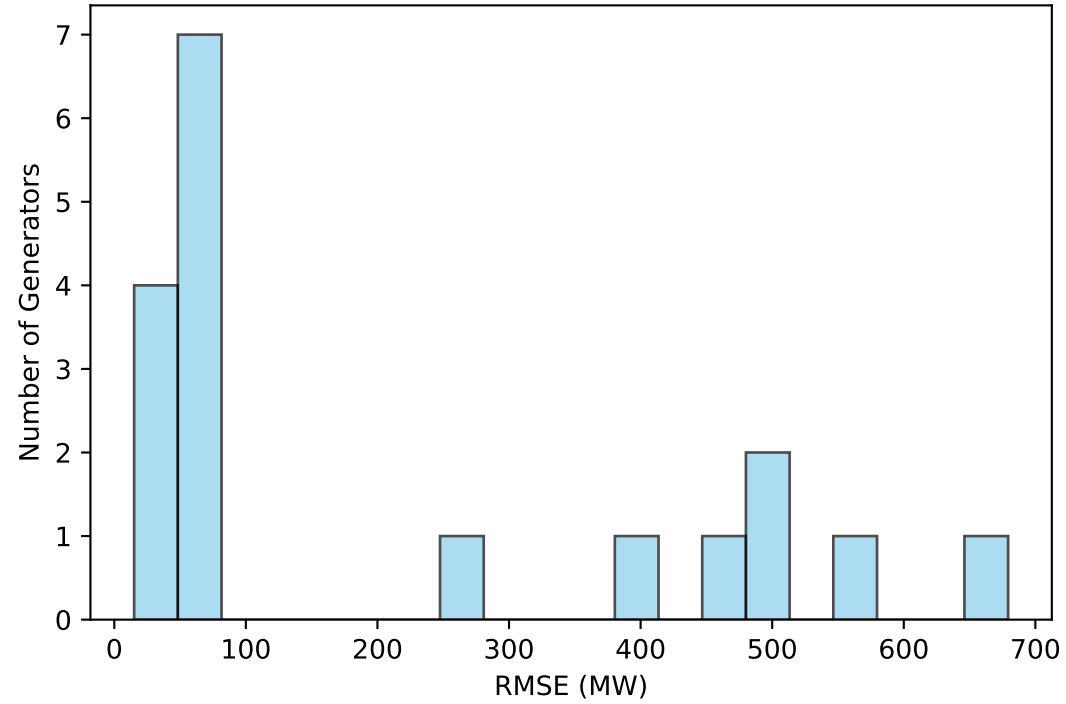
FILTERING APPLIED: Small generators are excluded from all tables if they meet BOTH of these criteria: Pmax < 1100 MW AND max actual generation < 1100 MW. (Previously used 3rd criterion 'max predicted generation' is no longer applied.)
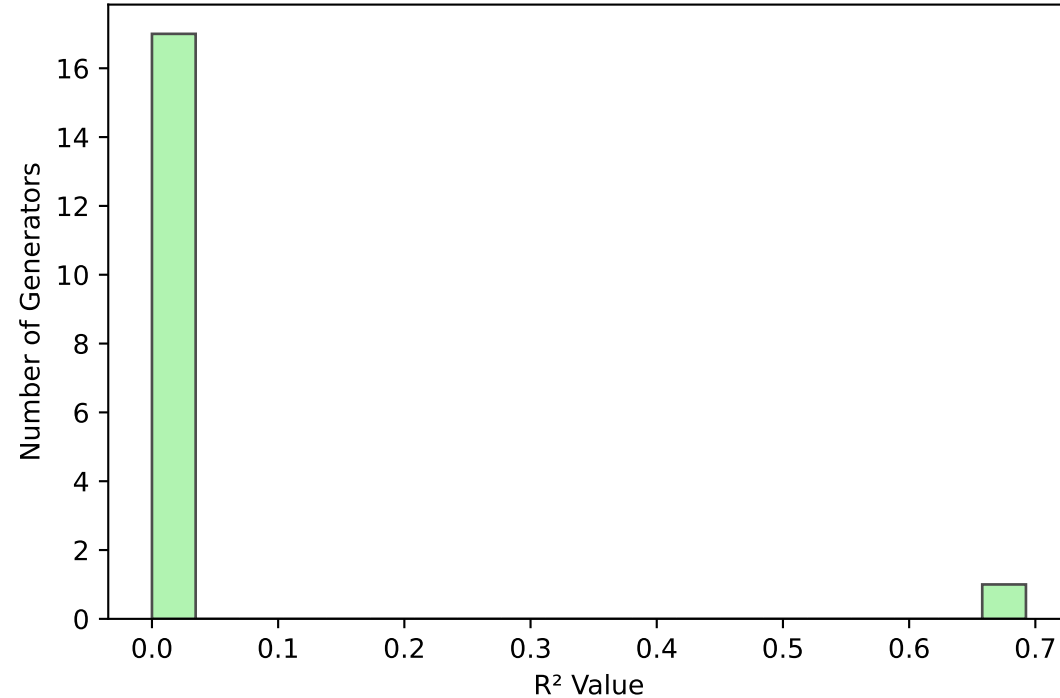
Executive Summary

Performance Classification Distribution

critical 94.4%

fair 5.6%
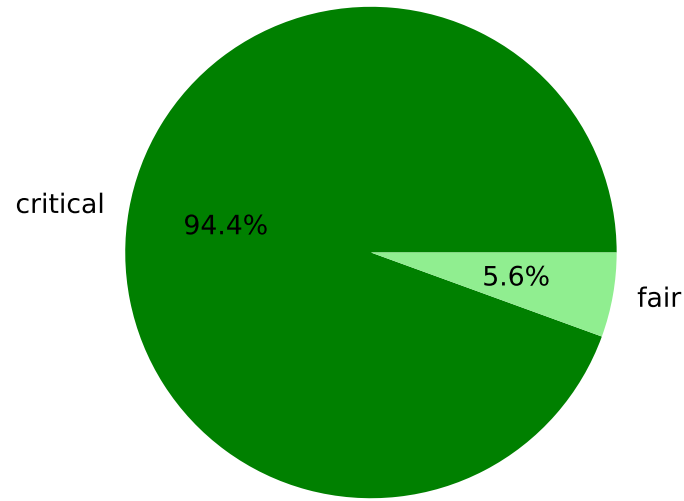
RMSE Distribution

R² Distribution

Key Statistics

Metric	Value
Total Generators (Raw)	18
Generators Analyzed	18
Small Generators Excluded	0
Anomalies Detected	18
Total Alerts	367
Poor/Critical Performers	17
Average RMSE (MW)	217.78
Average R²	0.038
Pmax Discrepancies (>5%)	12

Performance Classification System

PERFORMANCE CLASSIFICATION SYSTEM

The system classifies each generator into one of 5 performance categories based on:
- RMSE as percentage of generator capacity (Pmax)
- R-squared correlation coefficient

Classification Criteria:
- EXCELLENT: RMSE ≤ 10.0% of Pmax, R^2 ≥ 0.7 (Highly accurate forecasts)
- GOOD: RMSE ≤ 20.0% of Pmax, R^2 ≥ 0.6 (Good forecast accuracy)
- FAIR: RMSE ≤ 30.0% of Pmax, R^2 ≥ 0.5 (Acceptable performance)
- POOR: RMSE ≤ 40.0% of Pmax, R^2 ≥ 0.2 (Needs attention)
- CRITICAL: RMSE > 40.0% of Pmax or R^2 < 0.0 (Immediate action required)

PERFORMANCE SCORE EXPLANATION:
The "Score" column represents a composite performance score (0-100) calculated as:
- 70% weight: Inverted RMSE percentage (lower RMSE = higher score)
- 20% weight: R-squared × 100 (higher correlation = higher score)
- 5% weight: Consistency score × 100 (more consistent = higher score)
- 5% weight: Inverted volatility score (lower volatility = higher score)

Higher scores (closer to 100) indicate better overall forecast performance.
Lower scores (closer to 0) indicate generators requiring immediate attention.

Performance Score Distribution
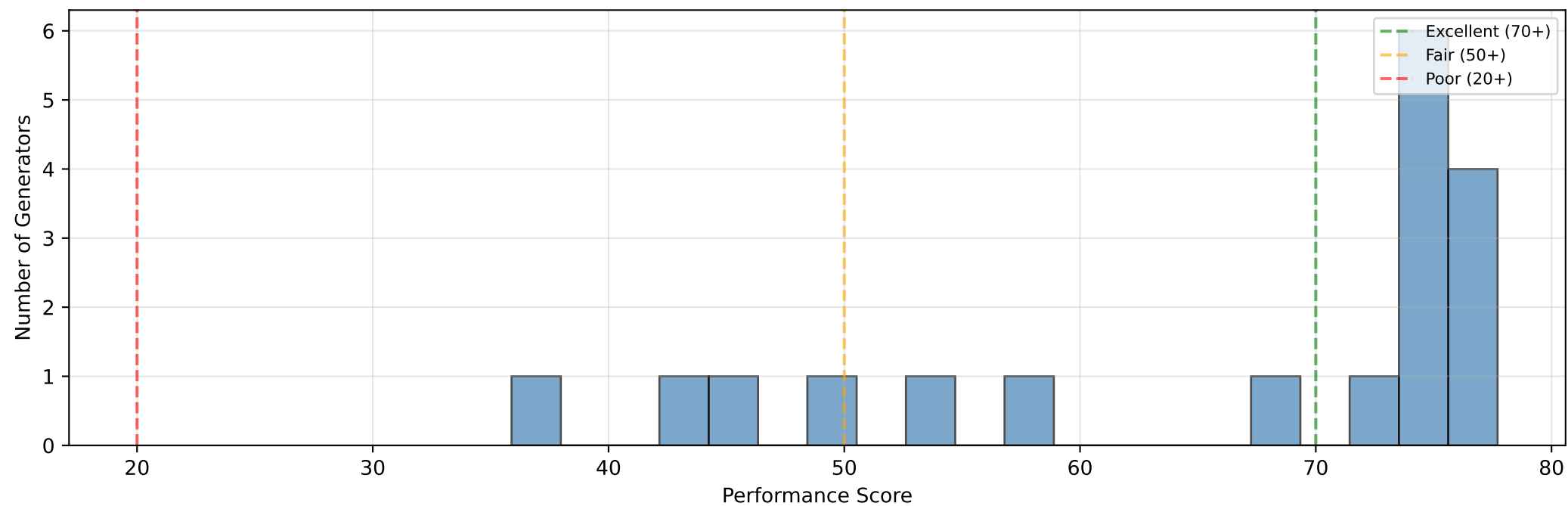
Generators requiring attention: 17 of 18 analyzed (18 total before filtering)

Generator Name	Plant ID	Unit ID	Pmax (MW)	Classification	Score	RMSE
ROCKPORT	6166	2	1300.0	critical	35.9	679.3
AMOS	3935	3	1330.0	critical	42.5	568.0
ROCKPORT	6166	1	1320.0	critical	45.8	497.0
MOUNTAI2	6264	1	1500.0	critical	50.0	454.9
GAVINAEP	8102	1	2001.0	critical	54.7	511.8
GAVINAEP	8102	2	2000.0	critical	57.6	413.6
PERRY_FE	6020	1	1330.0	critical	72.1	56.0
WATERF	4270	3	1214.0	critical	73.8	73.6
20_BRAID	6022	2	1238.0	critical	73.9	62.4
1_LASALL	6026	1	1255.0	critical	74.7	22.8
COOK	6000	2	1220.0	critical	74.7	68.1
CLINTON0	204	1	1095.0	critical	74.8	26.8
20_BRAID	6022	1	1273.0	critical	74.9	68.7
BYRON000	6023	1	1265.0	critical	76.1	52.9
BYRON000	6023	2	1265.0	critical	76.1	53.6
FERMI	1729	2	1195.0	critical	77.4	22.1
1_LASALL	6026	2	1354.0	critical	77.7	15.1

Chronic Forecast Error Detection

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CHRONIC FORECAST ERROR DETECTION

Identifies generators with persistent forecasting problems over extended periods:

- CHRONIC OVER-FORECASTING: Forecast consistently > 2x actual generation for 3+ days in any 5-day window
- CHRONIC UNDER-FORECASTING: Forecast consistently < 0.5x actual generation for 3+ days in any 5-day window

Detection Criteria:
- Minimum 3 problematic days in any 5-day sliding window
- Minimum 2 hours of data per day to qualify (adjusted for 3x daily sampling)
- Only considers periods with generation ≥ 5 MW to avoid noise
- All detected chronic patterns are classified as medium severity

Impact: Chronic errors indicate systematic model issues requiring immediate attention.
This approach detects sustained chronic patterns while reducing sensitivity to short-term market volatility.
Regular 5-day window monitoring provides balanced detection of forecast degradation.


METHODOLOGY:

The sliding window approach analyzes forecast accuracy over time:

1. Daily Statistics: Calculate daily average forecast-to-actual ratios for each generator
2. Sliding Windows: Apply 5-day sliding windows across the analysis period
3. Pattern Detection: Identify periods where forecast ratios exceed thresholds:
   - Over-forecasting: Forecast/Actual ≥ 2.0 (forecast is at least 200% of actual)
   - Under-forecasting: Forecast/Actual ≤ 0.5 (forecast is 50% or less of actual)
4. Severity Classification:
   - Medium Severity: 3+ problematic days in any 5-day window

This methodology ensures robust detection of persistent forecasting issues while minimizing
false positives from temporary market disruptions or operational anomalies.
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Chronic Error Generators - Analysis Results
Chronic Error Generators (Unique)

Generator	Plant ID	Unit ID	Error Type	Pattern	Pmax	Severity
GAVINAEP GV1	8102	1	UNDERF, OVER	5 days	2001.0 MW	medium
GAVINAEP GV2	8102	2	UNDERF, OVER	5 days	2000.0 MW	medium
MOUNTAI2 MT1	6264	1	UNDERF, OVER	5 days	1500.0 MW	medium
1_LASALL LA-2	6026	2	OVERFO	5 days	1354.0 MW	medium
AMOS AM3	3935	3	UNDERF, OVER	5 days	1330.0 MW	medium
PERRY_FE PR10	6020	1	OVERFO	5 days	1330.0 MW	medium
ROCKPORT RP1	6166	1	UNDERF, OVER	5 days	1320.0 MW	medium
ROCKPORT RP2	6166	2	UNDERF, OVER	5 days	1300.0 MW	medium
20_BRAID BR-1	6022	1	OVERFO	5 days	1273.0 MW	medium
CALLAWAY 1	6153	1	OVERFO	5 days	1270.0 MW	medium
BYRON000 BY-1	6023	1	OVERFO	5 days	1265.0 MW	medium
BYRON000 BY-2	6023	2	OVERFO	5 days	1265.0 MW	medium
1_LASALL LA-1	6026	1	OVERFO	5 days	1255.0 MW	medium
20_BRAID BR-2	6022	2	OVERFO	5 days	1238.0 MW	medium
COOK CK2	6000	2	UNDERF, OVER	5 days	1220.0 MW	medium
WATERF G3	4270	3	OVERFO	5 days	1214.0 MW	medium
FERMI FE2	1729	2	OVERFO	5 days	1195.0 MW	medium
CLINTON0 CLNTN_U1	204	1	OVERFO	5 days	1095.0 MW	medium

Pmax Discrepancy Analysis - Data Synchronization Issues

Pmax Discrepancy Analysis compares generator capacity values from two sources:
• P_MAX_ACTUAL: Capacity from Reflow operational data
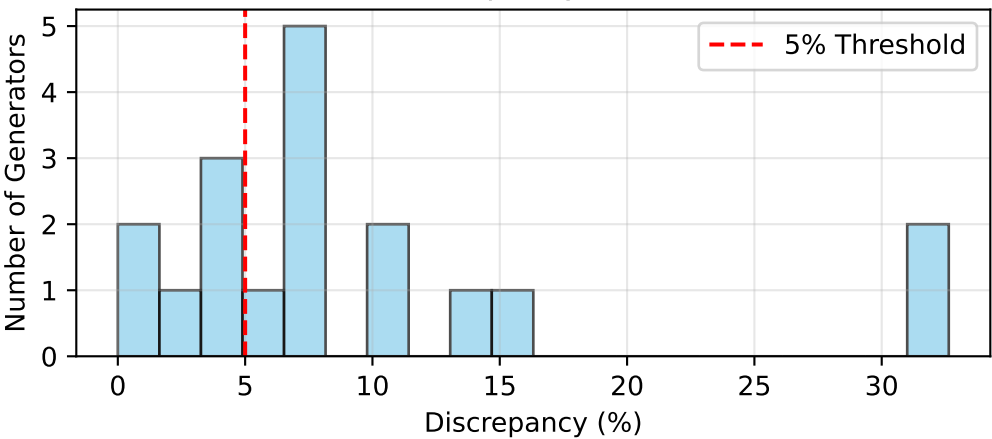• P_MAX_FORECAST: Capacity from ResourceDB system

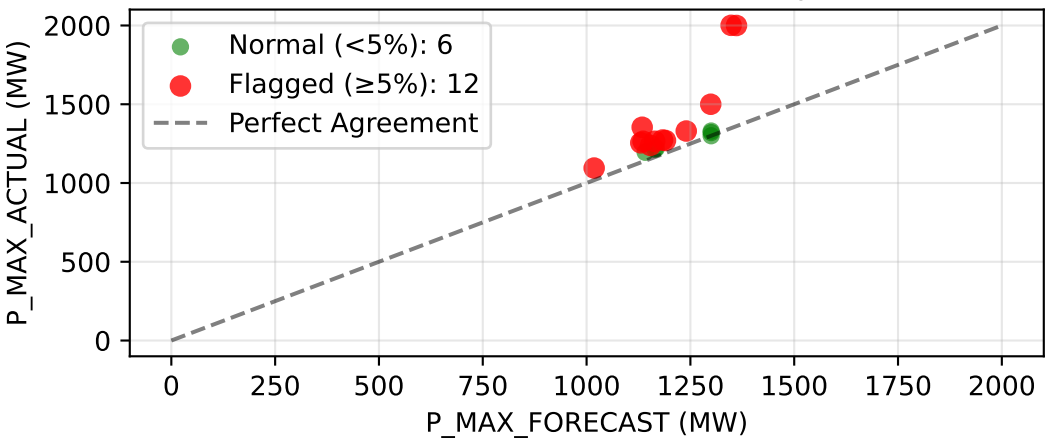Discrepancies >5% may indicate data synchronization issues between systems.

Analysis Summary:
• **Total generators analyzed: 18**
• **Generators with >5% discrepancy: 12 (66.7%)**
• **Average discrepancy: 9.6%**
• **Maximum discrepancy: 32.6%**

Top 10 Generators with Pmax Discrepancies

| Generator	Reflow (MW)	ResourceDB (MW)	Difference (MW)	Discrepancy (%)	Fuel
GAVINAEP	2001.0	1348.0	+653.0	32.6%	nan
GAVINAEP	2000.0	1361.0	+639.0	31.9%	nan
1_LASALL	1354.0	1133.9	+220.1	16.3%	nan
MOUNTAI2	1500.0	1299.0	+201.0	13.4%	nan
BYRON000	1265.0	1136.0	+129.0	10.2%	nan
1_LASALL	1255.0	1130.5	+124.5	9.9%	nan
BYRON000	1265.0	1164.0	+101.0	8.0%	nan
20_BRAID	1273.0	1183.0	+90.0	7.1%	nan
CLINTON0	1095.0	1018.3	+76.7	7.0%	Nuclear, Natural Gas
20_BRAID	1238.0	1154.0	+84.0	6.8%	nan

Advanced Forecast Metrics Analysis

Advanced Forecast Metrics

- CONSISTENCY SCORE (0-1): Measures how consistent forecast errors are over time (higher = better)
- VOLATILITY SCORE: Rolling standard deviation of forecast errors (lower = better)
- TREND ANALYSIS: Statistical trend in forecast performance (improving/stable/deteriorating)
- RMSE % OF CAPACITY: RMSE normalized by generator capacity for fair comparison

Consistency Score Distribution
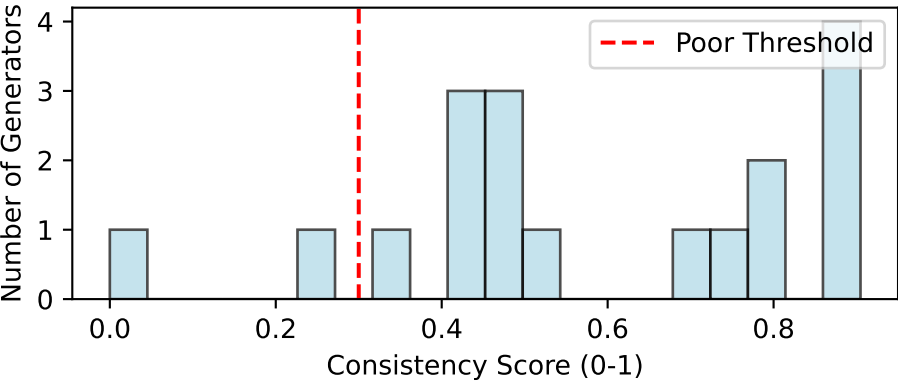
Volatility Score Distribution
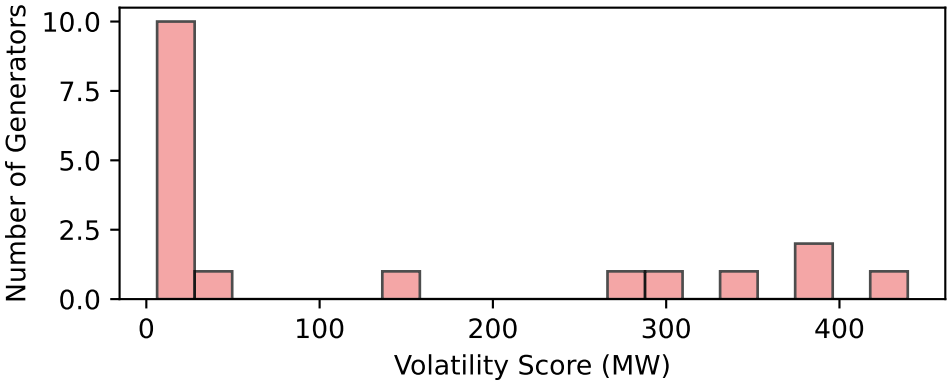
Bottom 10 Percentile: Lowest Consistency Score

Generator	Plant ID	Unit ID	Pmax (MW)	Consistency Score	RMSE	Class	Fuel
CALLAWAY	6153	1	N/A	0.000	273.2	fair	Nuc

Bottom 10 Percentile: Highest Volatility Score

| Generator	Plant ID	Unit ID	Pmax (MW)	Volatility Score	RMSE	Class	Fuel
MOUNTAI2	6264	1	N/A	439.420	454.9	crit	Unk

Statistical Anomaly Detection

Statistical Anomaly Detection

Uses population statistics to identify generators with anomalous performance:

- RMSE Z-SCORE: How many standard deviations above/below population mean (threshold: >2.0)
- MAE Z-SCORE: Mean Absolute Error compared to population (threshold: >2.0)
- POPULATION OUTLIERS: Generators performing significantly worse than peers

Generators with Z-scores > 2.0 are flagged for investigation.
Z-scores > 3.0 are considered critical and require immediate attention.

RMSE Z-Score Distribution

Statistical Anomalies (Z-Score > 2.0)
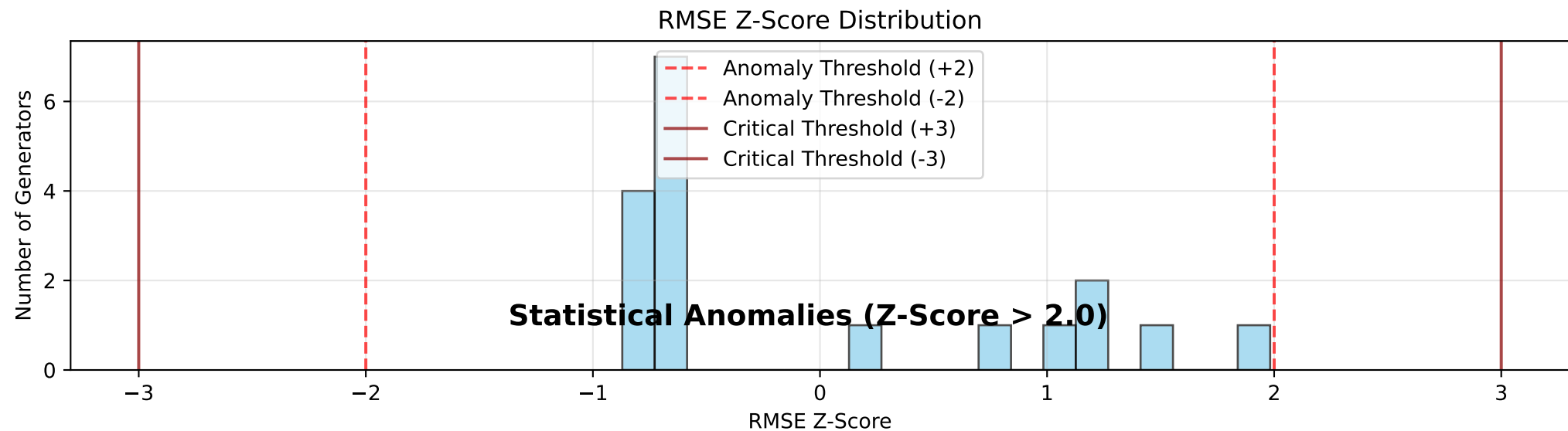
| Generator Name	Plant ID	Unit ID	Pmax (MW)	RMSE Z-Score	Severity	Class
ROCKPORT	6166	2	1300.0	1.98	High	crit

Operational Characteristics Analysis

OPERATIONAL CHARACTERISTICS

Analysis of generator operational patterns and their impact on forecast accuracy:

- CAPACITY UTILIZATION: Percentage of time generator is running
- MUST-RUN STATUS: Whether generator runs consistently (baseload characteristics)
- GENERATION PATTERNS: Zero vs non-zero generation frequencies
- CAPACITY FACTORS: Relationship between Pmax and actual generation patterns

These characteristics help identify if poor forecasts are due to operational complexity.

Average RMSE by Fuel Type

Low Utilization Generators with Poor Performance
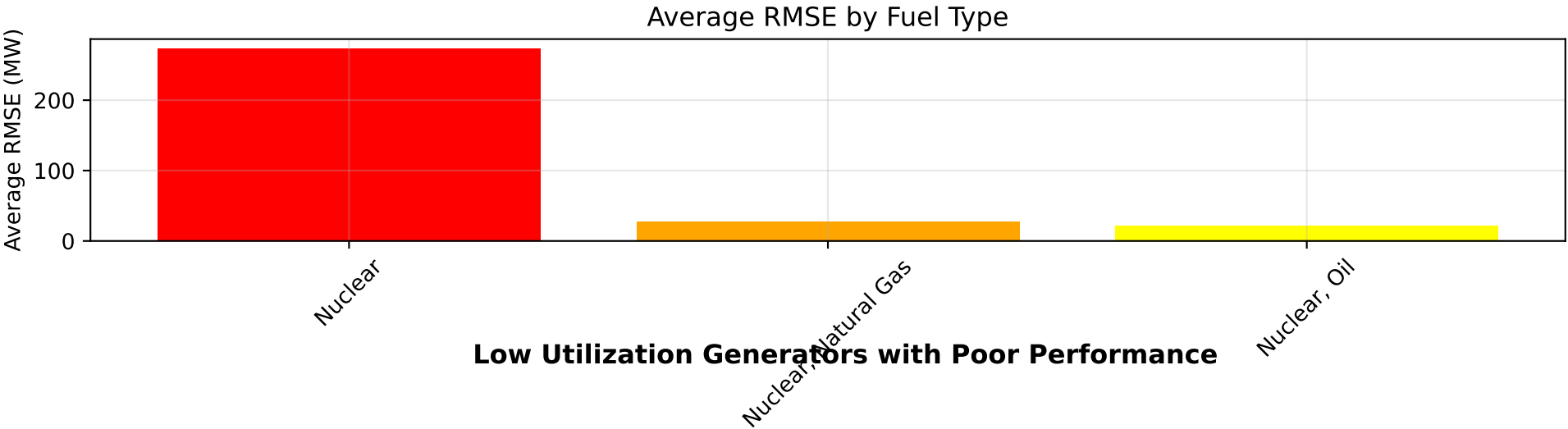
Generator	Plant ID	Unit ID	% Running	RMSE	Class	Fuel	Pattern
ROCKPORT	6166	2	1.0%	679.3	critical	Unknow	Intermittent
AMOS	3935	3	1.0%	568.0	critical	Unknow	Intermittent
GAVINAEP	8102	1	1.0%	511.8	critical	Unknow	Intermittent
ROCKPORT	6166	1	1.0%	497.0	critical	Unknow	Intermittent
MOUNTAI2	6264	1	1.0%	454.9	critical	Unknow	Intermittent
GAVINAEP	8102	2	0.9%	413.6	critical	Unknow	Intermittent
WATERF	4270	3	1.0%	73.6	critical	Unknow	Intermittent
20_BRAID	6022	1	1.0%	68.7	critical	Unknow	Intermittent
COOK	6000	2	1.0%	68.1	critical	Unknow	Intermittent
20_BRAID	6022	2	1.0%	62.4	critical	Unknow	Intermittent

Recommendations and Action Items

 CRITICAL: 17 generators with critical performance require immediate model review

 CHRONIC ERRORS: 18 generators with chronic forecasting patterns

→ Review dispatch model parameters and operational constraints

→ Analyze market conditions during chronic error periods

 GENERAL RECOMMENDATIONS:

• Prioritize generators with multiple performance issues

• Review forecast models for generators with $R^2 < 0.5$

• Monitor generators with increasing error trends

• Update capacity constraints for generators with Pmax issues

• Consider market condition correlation analysis

 FOLLOW-UP ACTIONS:

• Schedule weekly performance monitoring

• Set up automated alerts for new chronic errors

• Review and update performance thresholds quarterly

• Coordinate with operations team for generators needing immediate attention