NYISO Wind Integration Activities

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Northeast Power Coordinating Council General Meeting
Governmental/Regulatory Affairs Advisory Group & Task Force on Coordination of Planning Joint Session
Saratoga, NY
September 23, 2008

For Discussion Purposes Only

Agenda

I. **Wind Plant Integration Issues**

II. **NYISO Wind Study Tasks**

III. **Wind Study Assumptions**

- *Study Years*
- *Study MW*

IV. **Wind Penetration & Machine Types**

V. **Study Activity**

VI. **Other Wind Study Activities**

- *NERC IVGTF*
- *Eastern Interconnection Wind integration Study*

Wind Plant Integration Issues

- **Transmission**
- **System Flexibility**
- **Operator Awareness and Practices**
  - *Forecasting*
- **Wind Generation Plant Performance & Standards**
  - *System Models*

NYISO Study Tasks

1. Develop study assumptions
    1. *Select study years,*
    2. *Develop wind generator penetration forecast,*
    3. *MW output profile, and*
    4. *MW load profile.*
2. Develop and implement performance monitoring for operating wind generators.
3. Review other regions' experience with wind generators.

NYISO Study Tasks (cont.)

4. Study the impacts on system operations of wind generators at various future levels of installed MW for the selected study years.
5. Evaluate the impact of the higher penetration of wind generation on system planning and the need for transmission infrastructure from a thermal, voltage and stability perspective.
6. Evaluate the impact of the higher penetration of wind generation on energy production by fuel types, LBMP/Congestion, reserve, regulation, load following costs and including the impact of selected facility outages on system operations as well as transmission expansion for future years.

Study Assumptions

- **Study Years**
  - *2011, 2013, 2018*

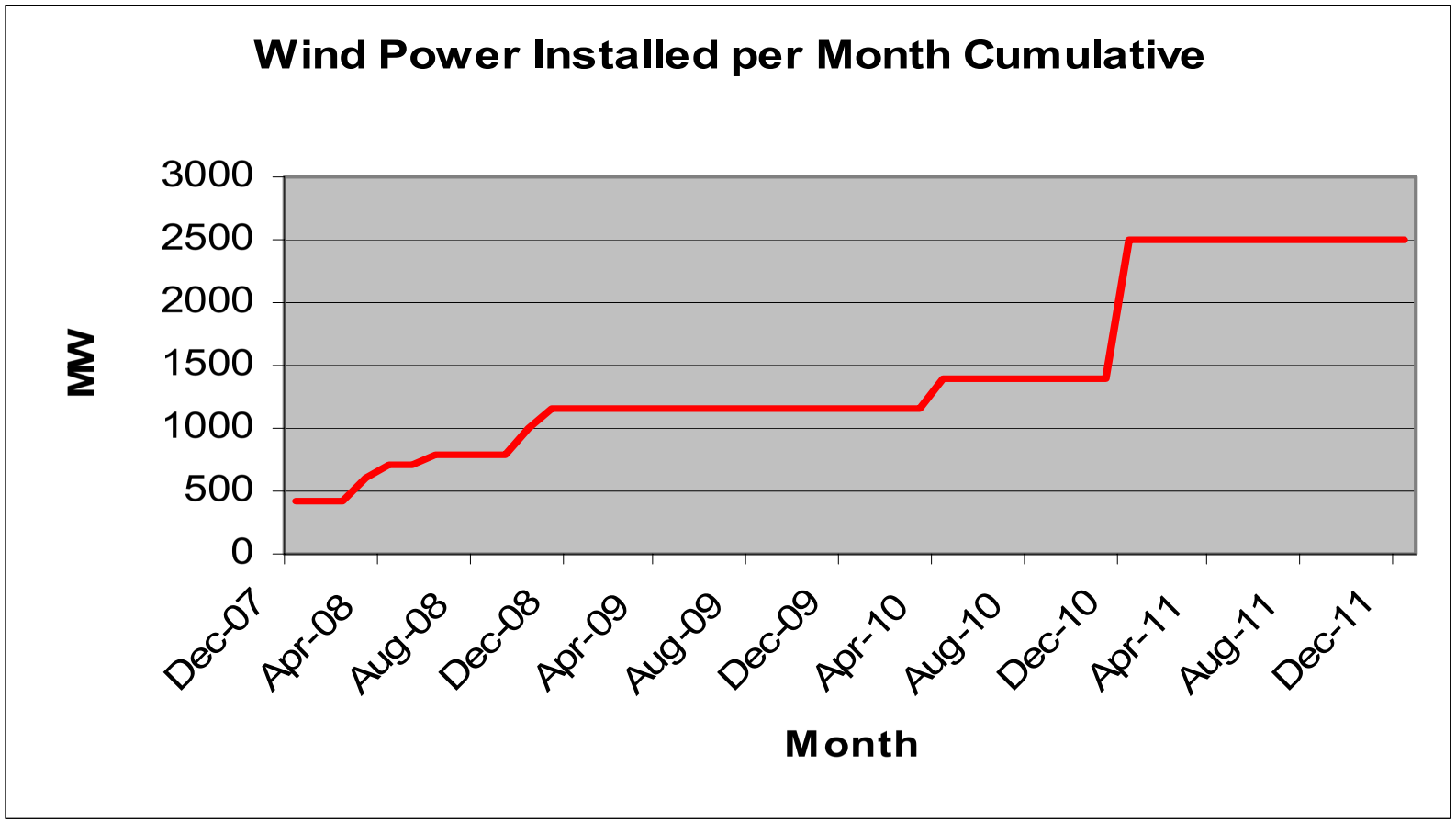
- **Level of Wind MW to be Studied**
  - ***2011*** *- Wind MW of approx. 10% and 12% of peak which = 3,500 MW and 4, 250 MW (4,250 = 6.5% of forecast energy at 30% capacity factor)*

  - ***2013*** *- Wind MW of approx. 12% and 17% of peak which = 4,250 MW and 6,000 MW (6,000 = 8.9% of forecast energy at 30% capacity factor)*

  - ***2018*** *- 6,000 and 8,000 MW (8,000 = 11.2% of forecast energy at 30% capacity factor)*

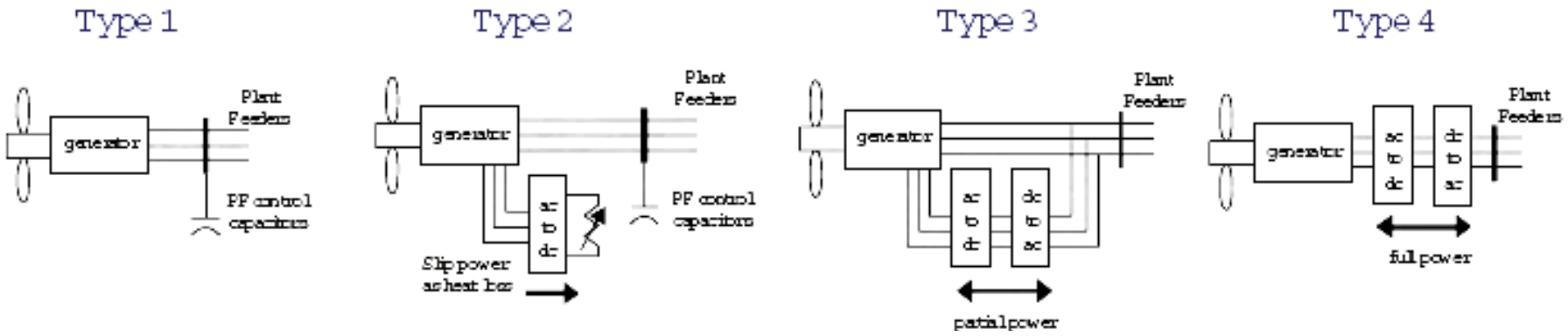
Wind Penetration Update

- **Have developed MW in service by months for all projects that have accepted cost allocation plus Class Year 07 and Class Year 08 candidates and potential Class Year 09 projects.**

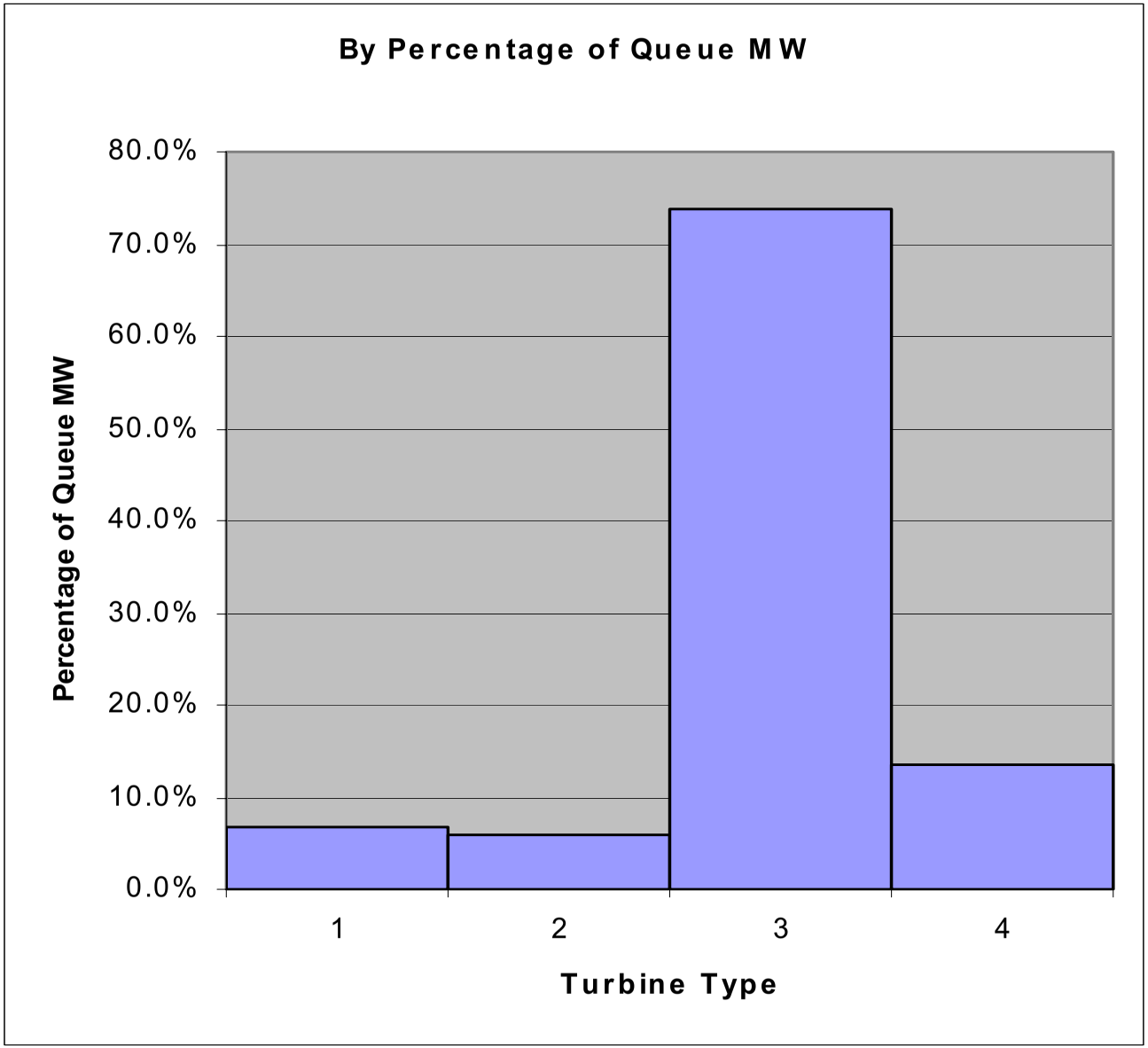


Standard Wind Turbine Types

- Four basic topologies based on grid interface
  - Type 1 – conventional induction generator
  - Type 2 – wound rotor induction generator with variable rotor resistance
  - Type 3 – doubly-fed induction generator
  - Type 4 – full converter interface



Distribution of Machine Types

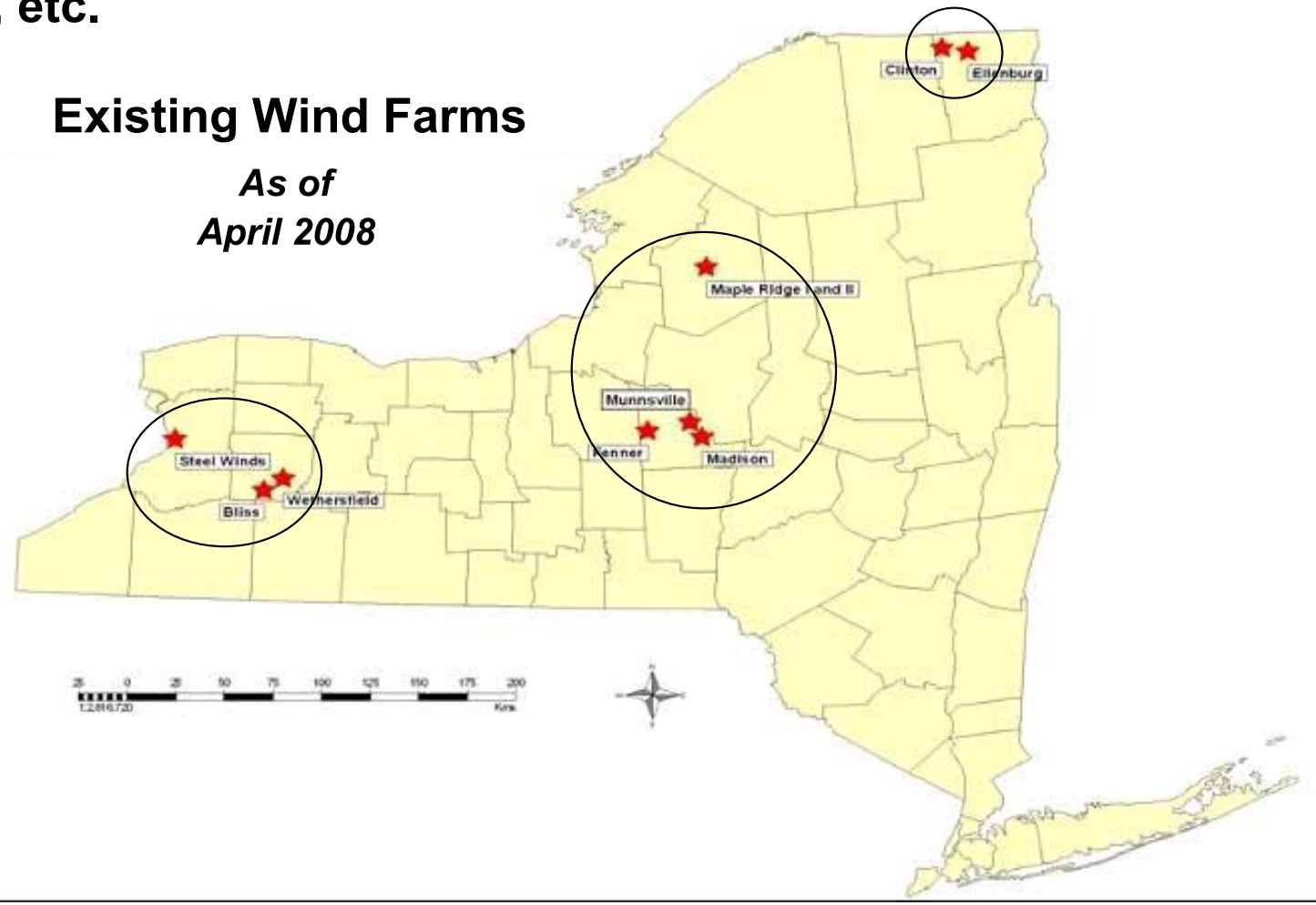


Wind Plant Performance Report

- **Tracks the performance of wind plants by months on a daily basis for key metrics such as maximum coincident wind plant output, total output at the time of the system peak, Mwh generated, capacity factor, etc.**

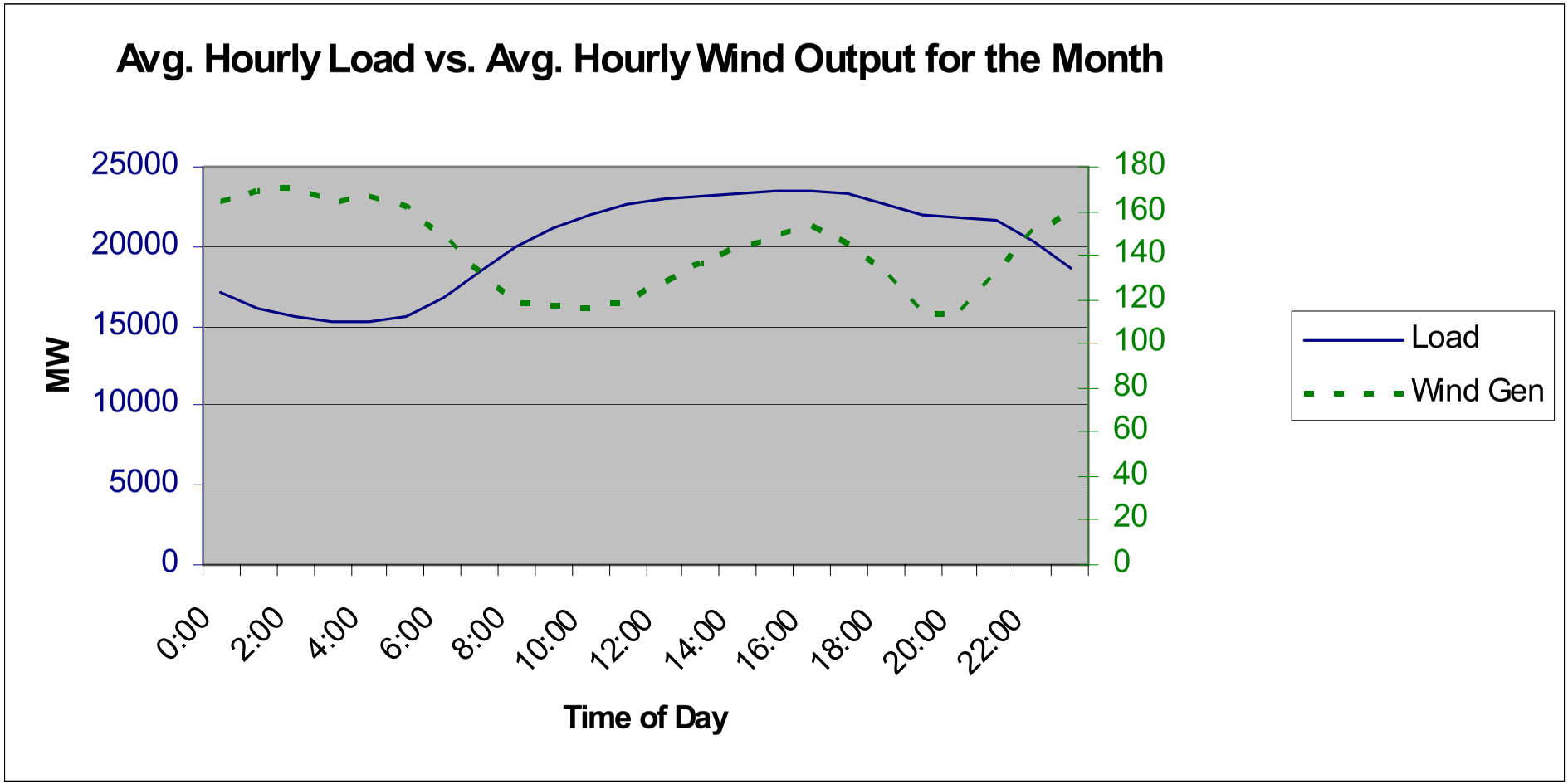
Existing Wind Farms

As of
April 2008



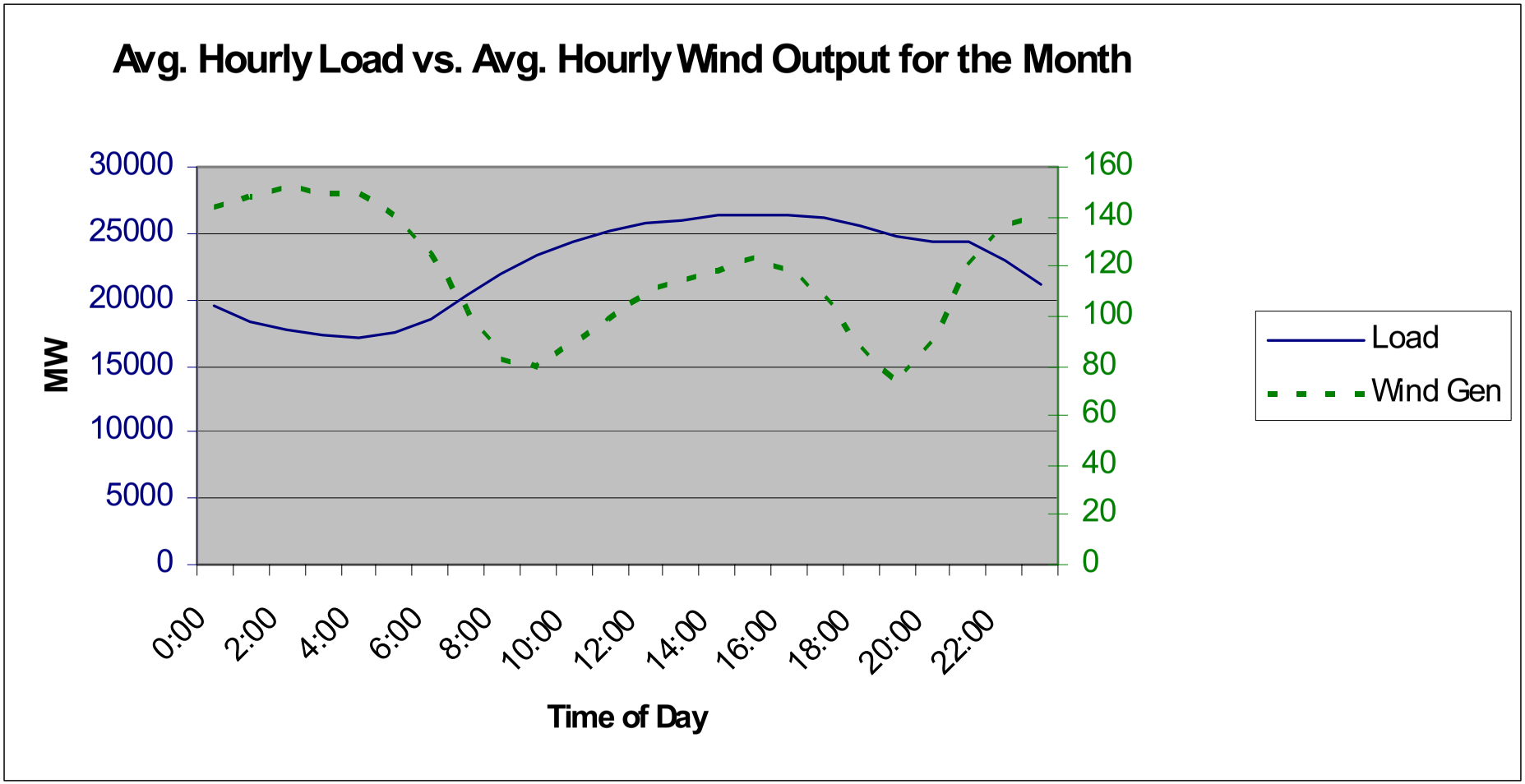
Performance Report (cont.)

Average Day - June



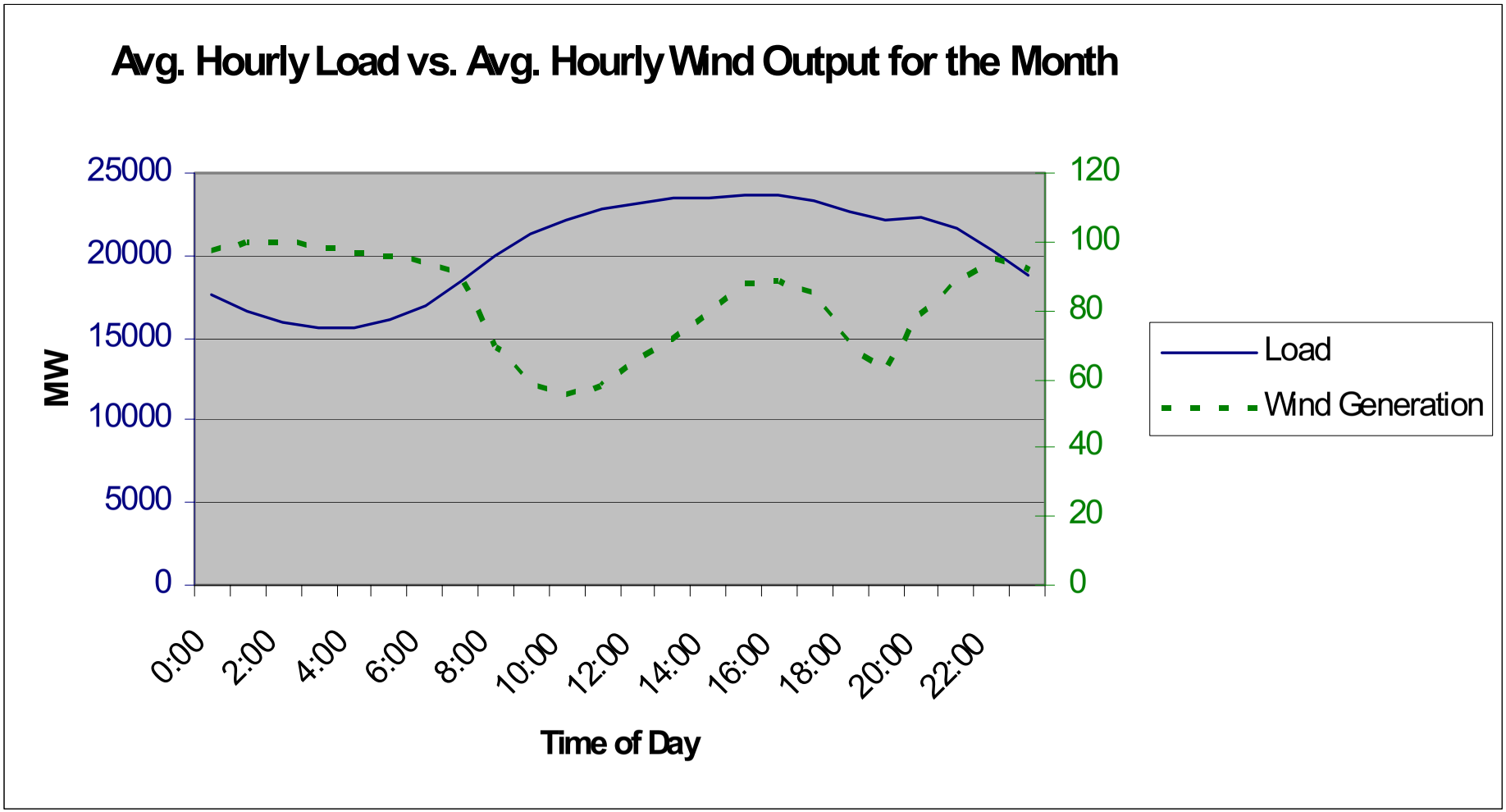
Performance Report (cont.)

Average Day - July



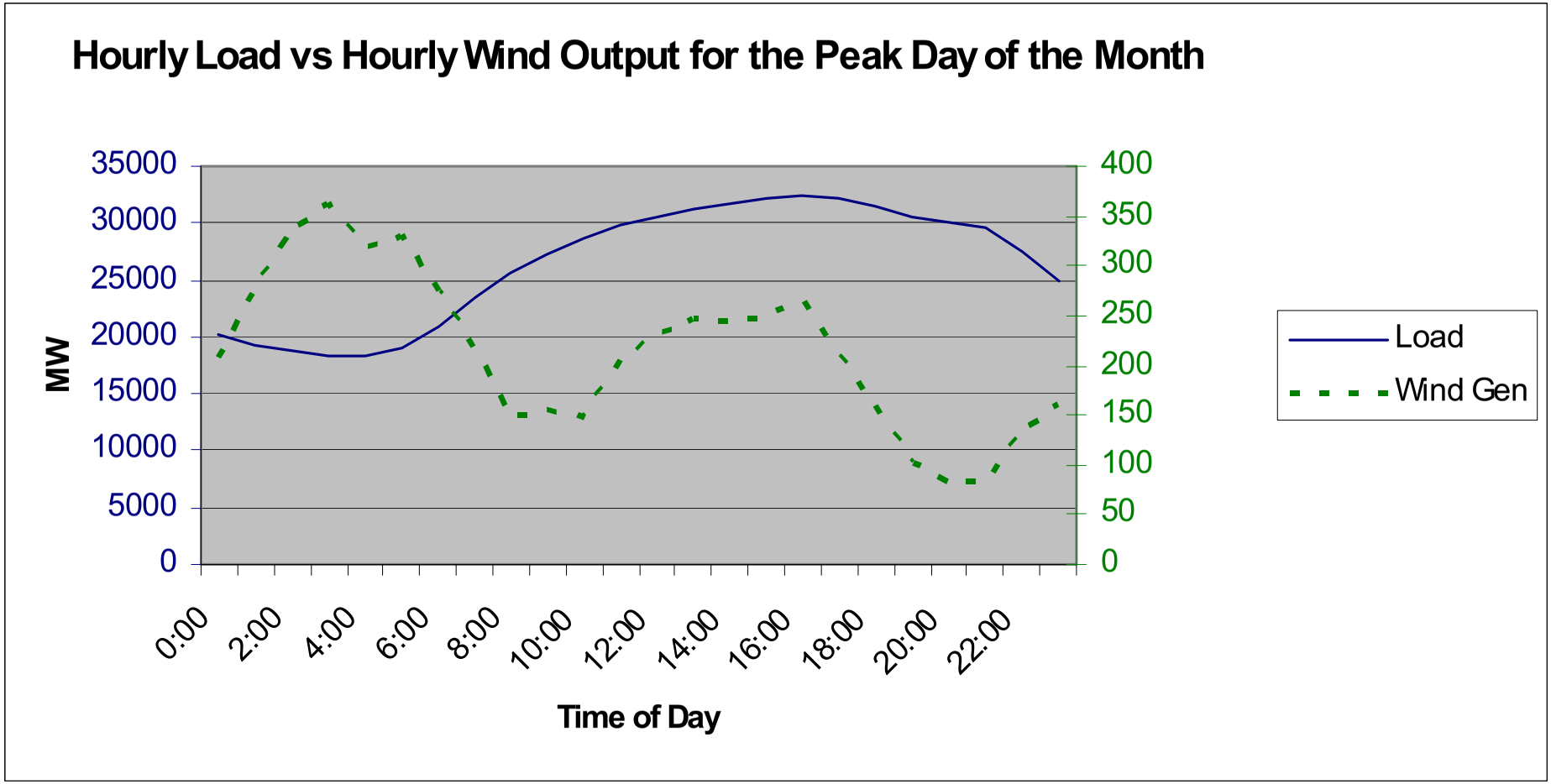
Performance Report (cont.)

Average Day - August



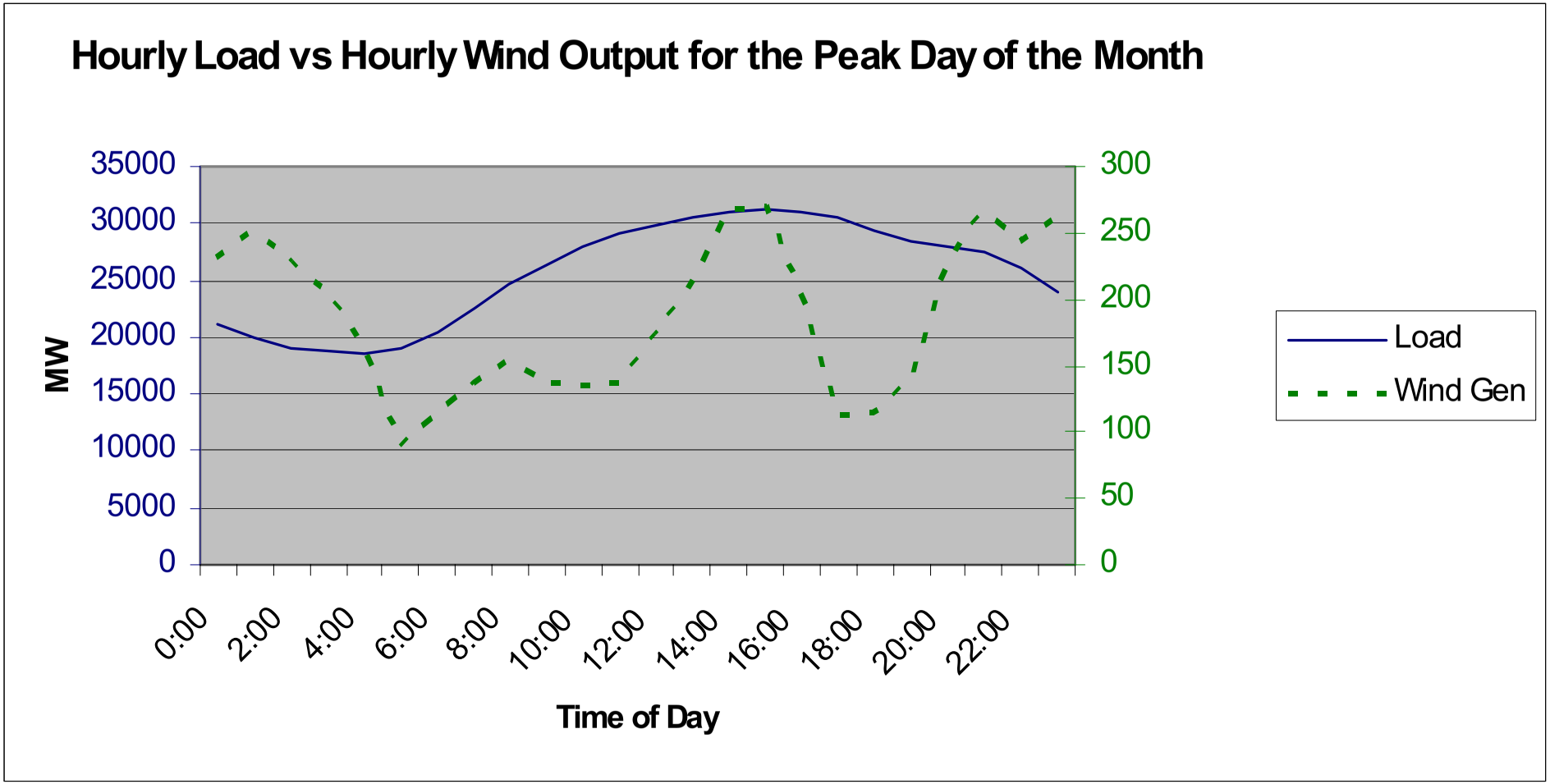
Performance Report (cont.)

Peak Day - June



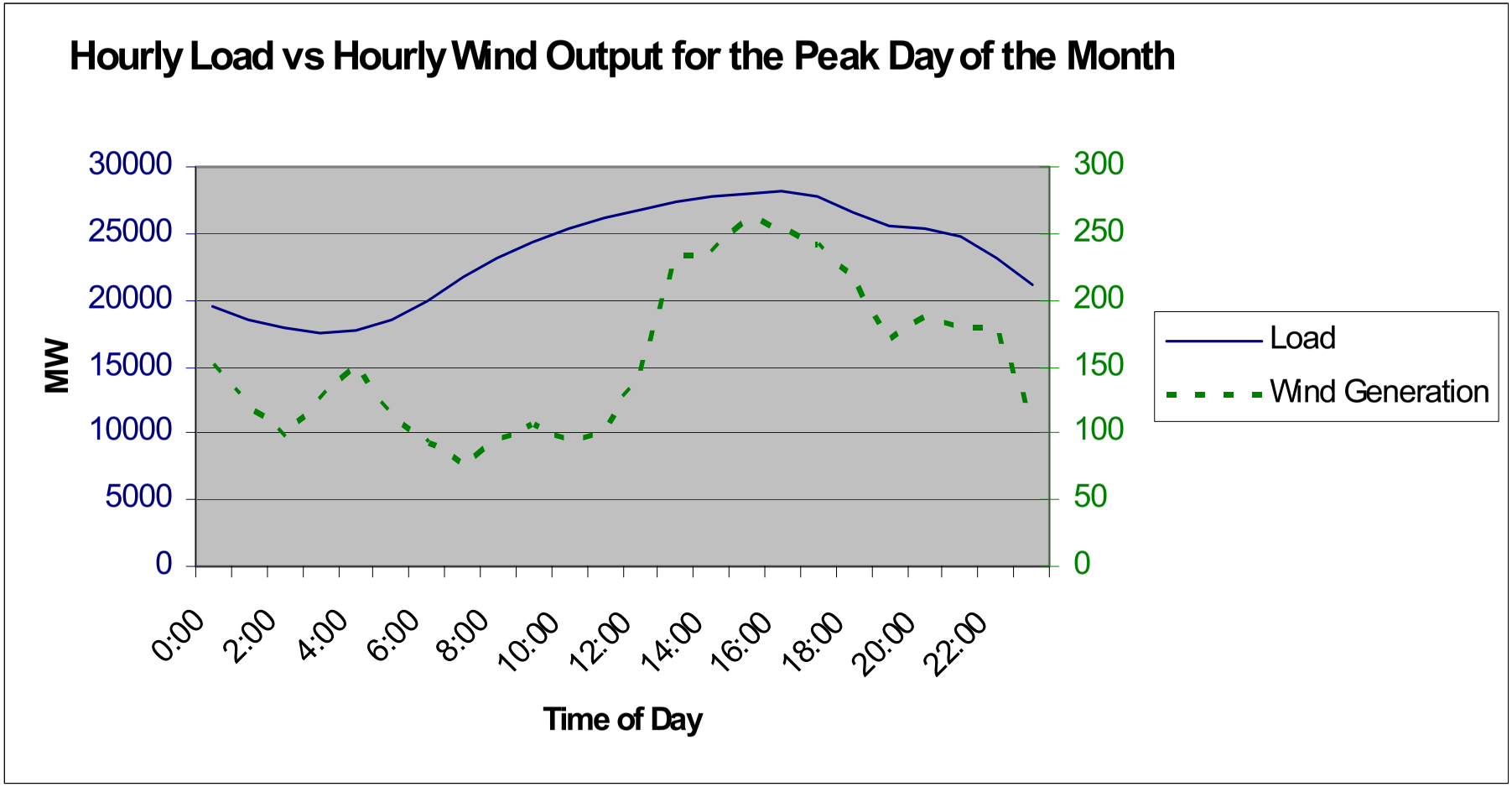
Performance Report (cont.)

Peak Day - July



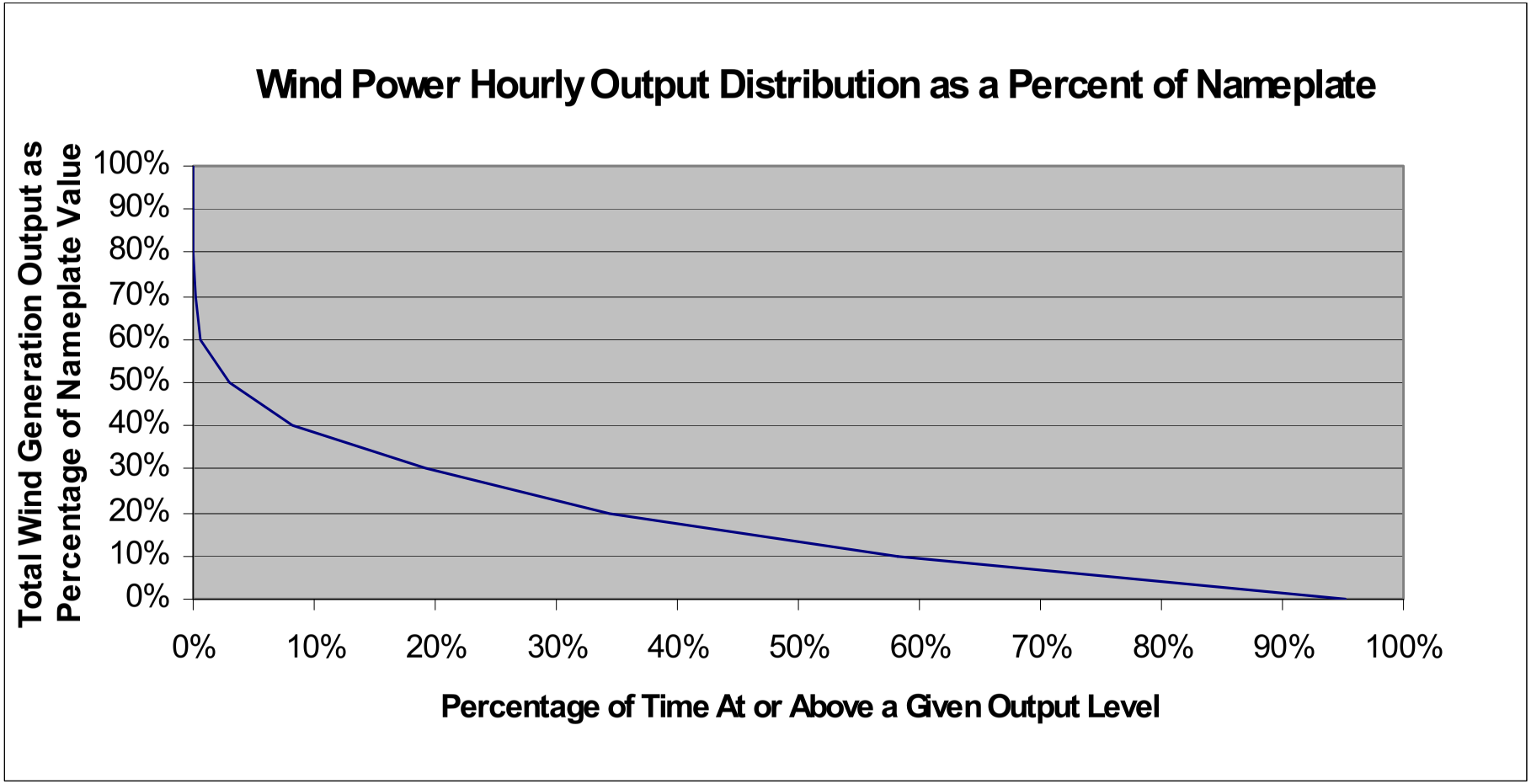
Performance Report (cont.)

Peak Day - August



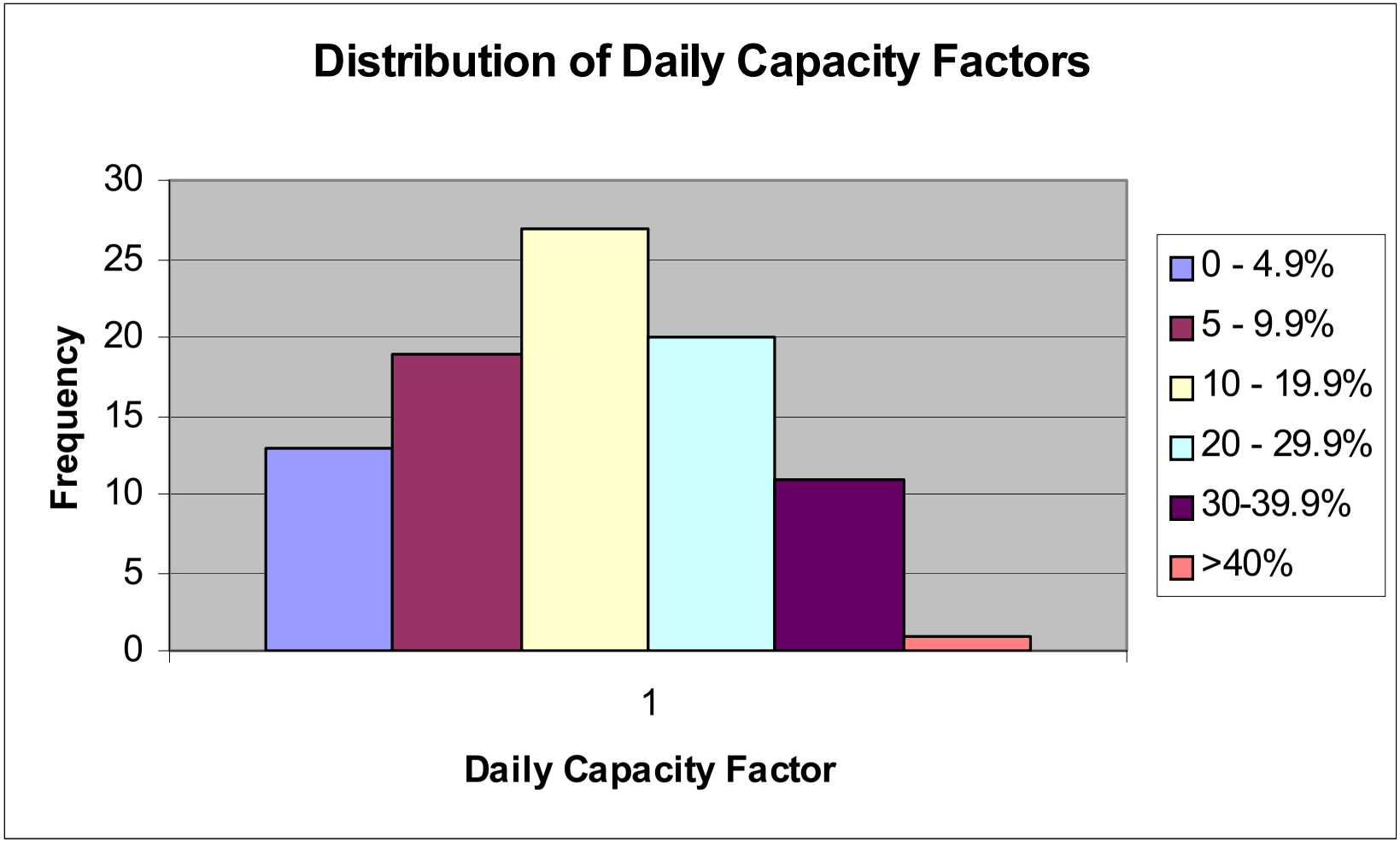
Performance Report (cont.)

Hourly Output Duration Curve - July



Performance Report (cont.)

Distribution of June Through August Daily Capacity Factors



Performance Report (cont.)

Other Statistics

Month	Nameplate Total MW	Average[1] Capacity Factor	Peak Hour Coincidence Factor (CF)[2,3]	Max 1 HR Output MW	Number Of Days with Hrs < 0
June	706	20.1%	39.3%	453.8	1
July	706	16.5%	38.2%	508.8	8
August	706	11.6%	35.8%	433.8	7[3]

1) The overall average capacity factor for the three summer months was 16.6%

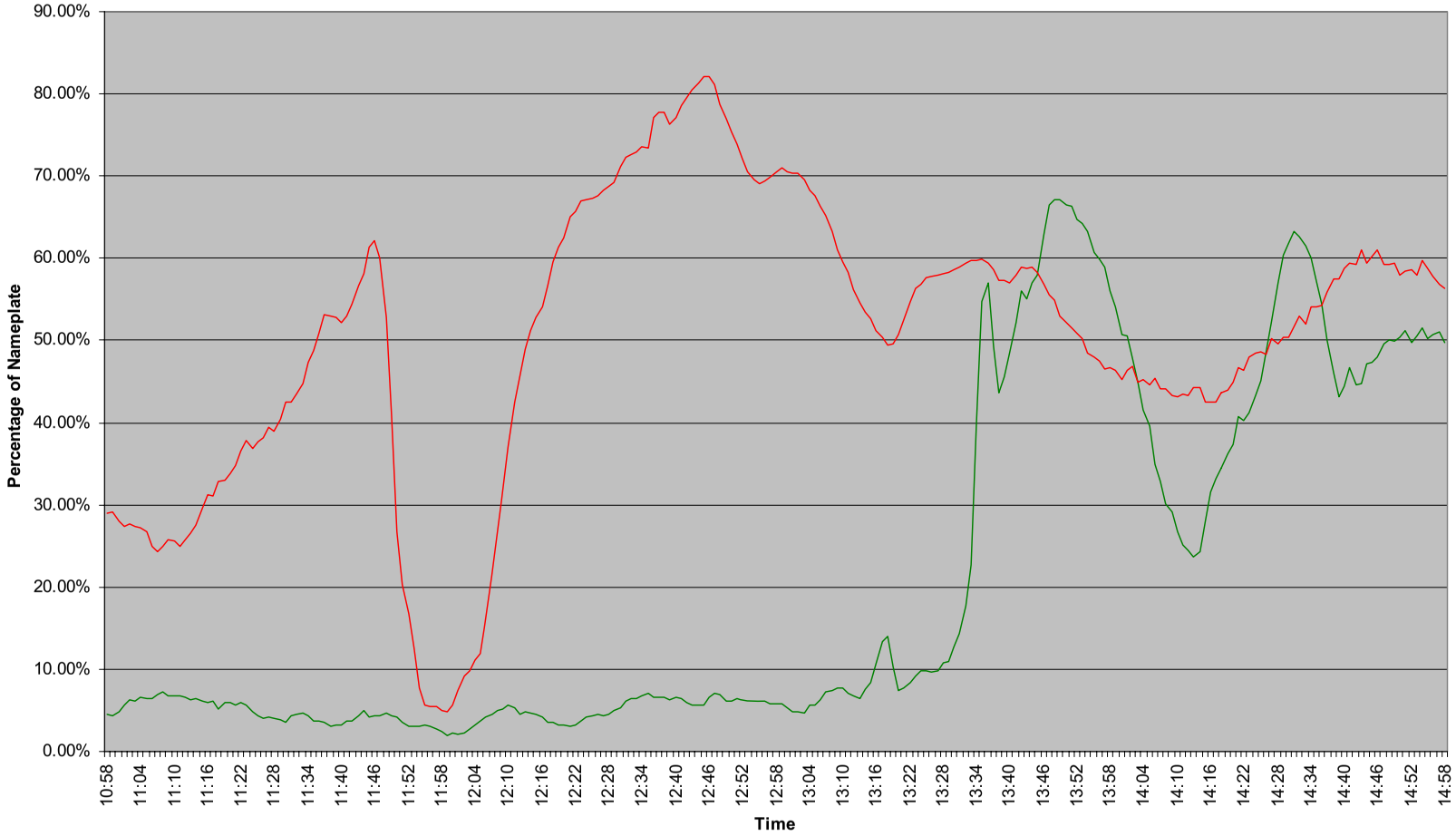
2) CF is the ratio of wind plant output at the system peak hour to nameplate

3) Capacity value is the wind plant capacity factor between the hours of 1400 and 1800 for the summer months of June, July and August. Summer 2008 value was 16.7%

4) Had one day where the aggregate output for the entire day was less than zero

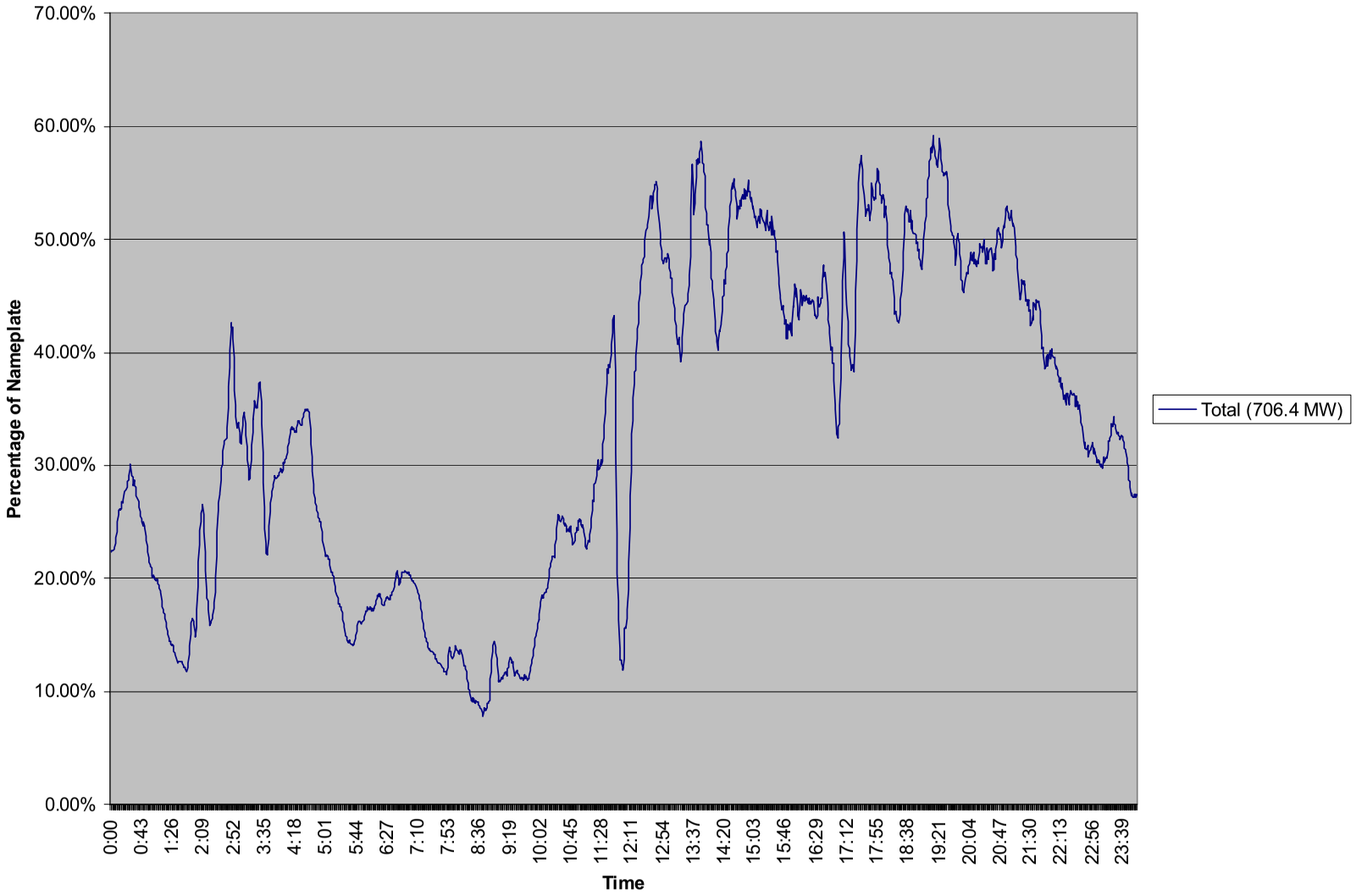
Performance Report (cont.)

- High Speed Cutout Event approx. 12 noon on 6/10/08 – Ramp up preceding the cutouts: 26% of nameplate to 61% of nameplate over 30 minutes. Ramp down from cutouts: To 5% of nameplate over 10 minutes. Ramp up after cutout event cleared: To 82% of nameplate over 45 minutes.



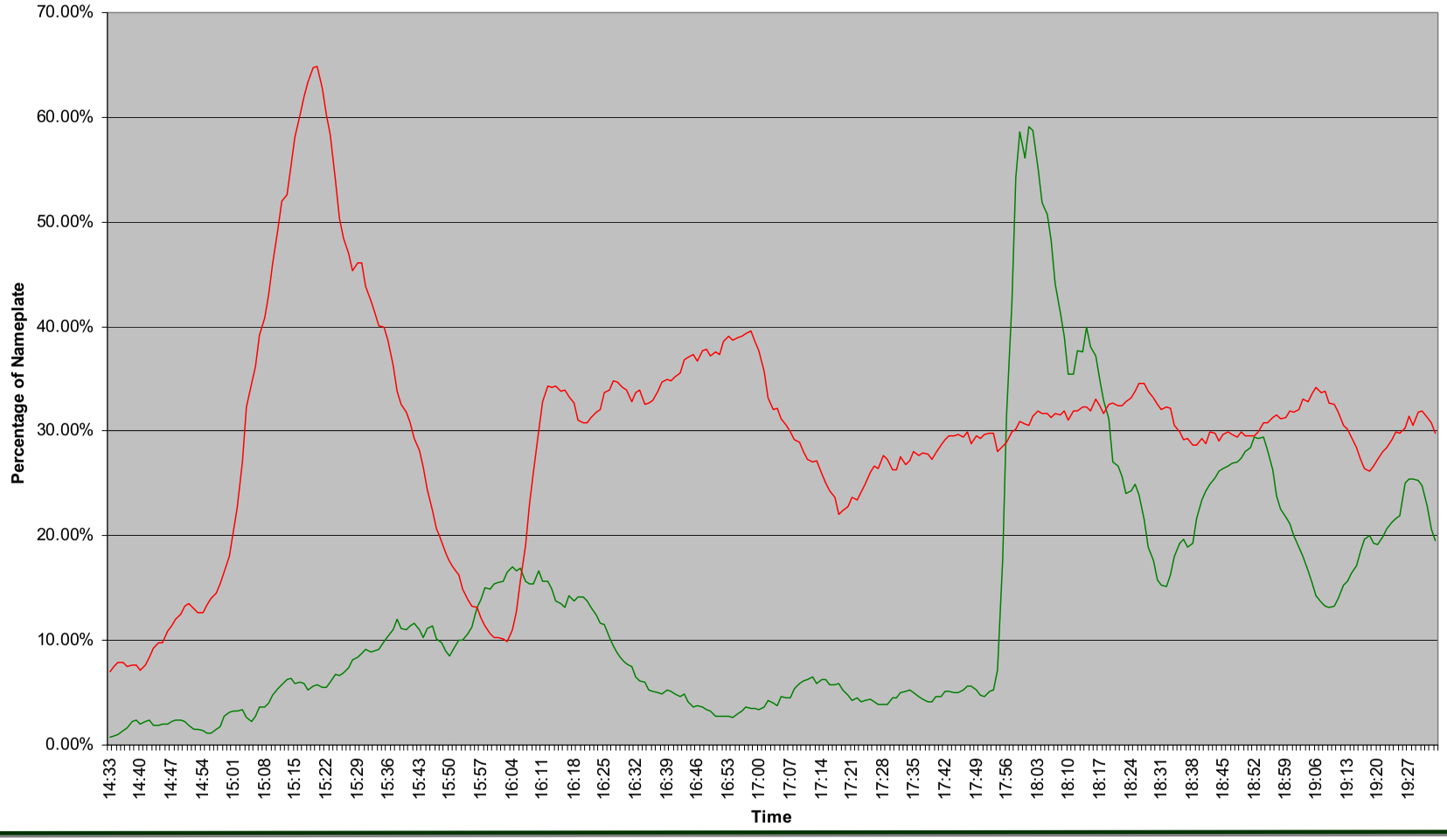
Performance Report (cont.)

System View for Full Day 6/10/08

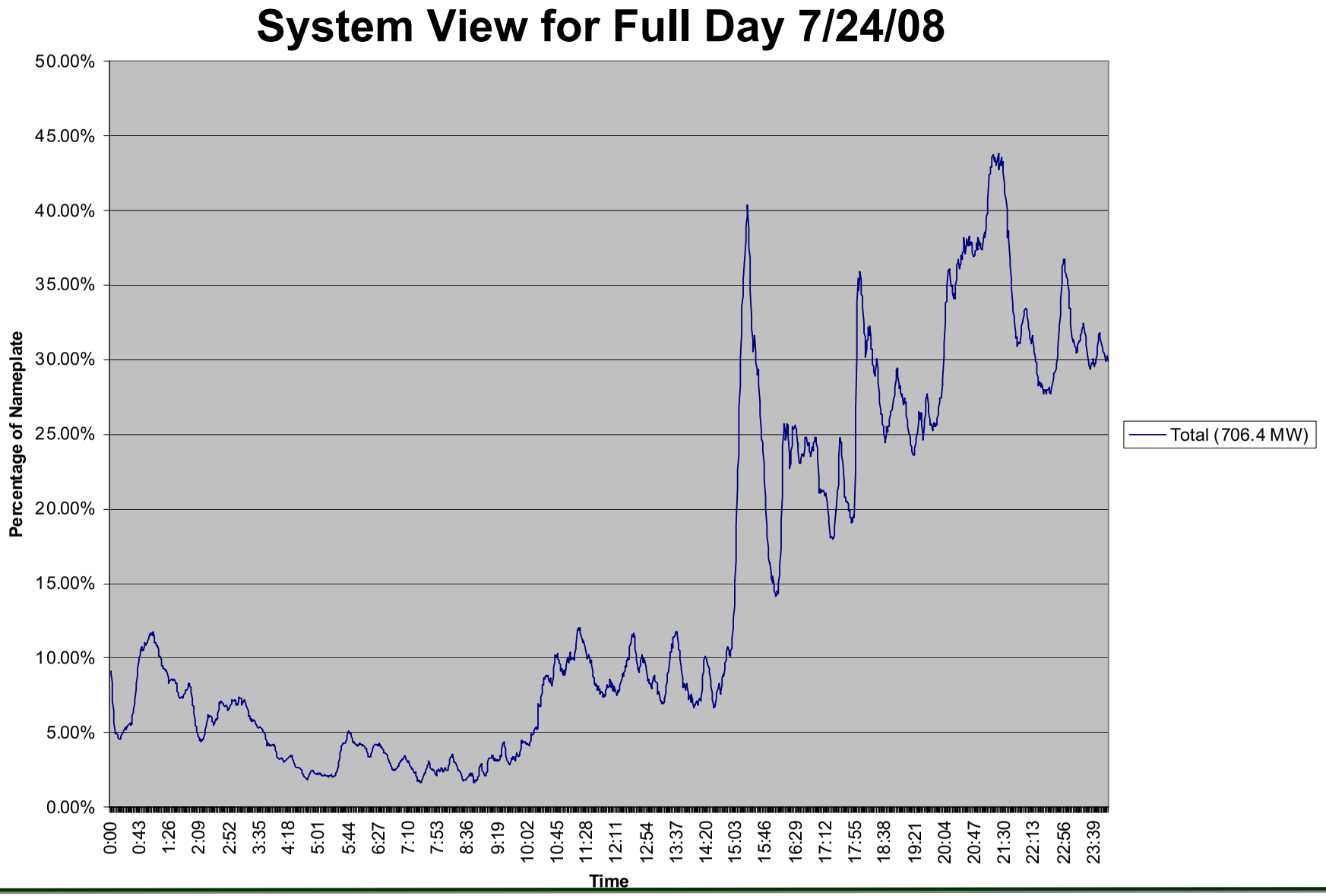


Performance Report (cont.)

- Another High Speed Cutout Event occurred on 7/24/08 – Ramp up preceding the cutouts: 10% of nameplate to 65% of nameplate over approx. 30 minutes. Ramp down from cutouts: To 10% of nameplate over approx. 45 minutes. Ramp up after cutout event cleared: To 37% of nameplate over 10 minutes.



Performance Report (cont.)



Experience with Wind Plants Europe, U.S. & Canada

- NYISO contracted with European Consultant to update the European Experience with Wind Generation – complete
- NYISO reviewed most recent studies conducted in California, Texas and the Province of Ontario

Experience with Wind Plants Europe, U.S. & Canada (cont.)

- Overall conclusions from the above reviews include:
  - *The primary insights that can be drawn from the review of the European and other studies is first that higher levels of installed wind generation above the 3,300 MW from a system operation perspective is feasible.*
  - *To achieve the higher penetration will require implementation of enhancements to and extension of existing operating protocols, procedures and reliability standards.*
  - *The major areas of ongoing concern that are common across all regions tend to focus on:*
    - Will there be sufficient transmission infrastructure to integrate the higher penetrations of wind?
    - Will sufficient resources be available when the higher penetration of wind generation are achieved to provide the operational flexibility that will be needed with higher penetration of variable generation?
    - Validation of wind turbine models needed for system studies.

Impact of Wind Plants on System Operations

- The NYISO is conducting a study to evaluate the impacts on system operations of penetration of installed wind plants above 3,300 MWs.
  - *One of the key questions that this study will addresses is: "What is the impact of wind variation on the intrinsic load variability already experienced by the New York Control Area?" Power systems are dynamic, existing in a continuously changing environment, and are impacted by factors that change from second-to-second, minute-to-minute, hourly, seasonally and year-to-year.*
- The analysis of system variability for various time scales from minutes to hours is being undertaken to assess the impact on such operating parameters as regulation, load following, operating reserves, ramping, and scheduling.
- AWS Truewind is developing the wind plant output based on 2004 through 2006 weather. Load models with one minute integrated demands have been developed.

Transmission Infrastructure Needs

- The NYISO will evaluate the impact of the higher penetration of wind generation on system planning from a thermal, voltage and stability perspective as well as the need for additional transmission infrastructure to support higher penetrations of wind.
  - *The study will use the RNA 2009-2013 case as the study base case.*
  - *The analysis will be conducted with 4,250 MW of nameplate installed wind.*
  - *The location of the wind plants will be determined by the NYISO interconnection queue in queue order.*
  - *A summer and winter peak case will be evaluated as well as a maximum wind output case under light load conditions.*
  - *The analysis will be repeated as determined from the results of the 4,250 MW case for 6,000 MW.*
- Because of the potential impact of wind plants on the New York and New England power systems coming on line by the end of 2008 in the Moses-Willis-Plattsburgh transmission corridor (a.k.a., the North Country Wind Farms), the NYISO is involved in a near term operational planning transmission study. This study is jointly being undertaken with New York and New England transmission owners and ISO-NE. This study is evaluating the integration of 408 MW of wind generation into the grid in that part of the system.

Production & Transmission Impacts of Wind Generation

- The study will evaluate the impact of the higher penetration of wind generation on electricity production by fuel types, LBMP, reserve, regulation, load following costs, etc. Also, the study will evaluate the impact of selected facility outages on system operations for future years. The overall objective is to evaluate the cost impact on system operations that result from the higher penetration of wind plants.
- This analysis will evaluate the impacts of transmission limitations and upgrades on congestion and electricity production by fuel type for much higher penetrations of wind plants above that studied in the 2004 Study (3,300 MW).

Summary of NYISO Timeline

Task	Begins	Analysis Completed
1	In progress	Complete
2	In progress	Ongoing
3	In progress	Complete
4	May	Nov./Dec.
5	June	Nov./Dec.
6	June	Nov./Dec.

Other Studies
NERC IVGTF

- The NYISO is participating in the **North America Electric Reliability Council's Integration of Variable Generation Task Force**. In December 2007 in anticipation of the growth of wind and other variable generation, NERC's Planning and Operating Committees created the Integration of Variable Generation Task Force.
- Task Force charged with preparing a report to include:
  1) philosophical and technical considerations for integrating variable resources into the Interconnection, and
  2) specific recommendations for practices and requirements, including reliability standards that cover the planning, operations planning, and real-time operating timeframes.
- Draft to NERC' Planning and Operating Committees due in September.

Other Studies
Eastern Interconnection Study

- The objective of the **Eastern Wind Integration and Transmission Study (EWITS)** being lead by **DOE/NREL (National Renewable Energy Lab)** is to help stakeholders, including regional utilities and transmission operators, to understand the costs and operating impacts of significant amounts of wind power on their grids and to help them in future transmission planning.
- NYISO is a member of the Technical Review Committee (TRC) organized by NREL
- Study years are 2018 and 2024.
- Preliminary work completed by MISO and Contractors as part of the Joint Coordinated System Plan (JCSP) which consist of MISO, PJM, SPP and TVA
- Preliminary results for the 20% scenarios indicates that west to east transfer capability in the eastern interconnection will have to be increased two to three fold to accommodate 20% wind.
- Secondary goal is to test the theory that it makes more sense to build wind in areas with high capacity factors and deliver it to load areas than to build wind plants with low capacity factors closer to load centers.
- Issue – Who pays for the transmission?
- Final report expected to be available in approximately one year from now.

Other Studies
Eastern Interconnection Study

- The work will consist of seven tasks:
  1. Examine high levels of wind penetration and answer specific stakeholder and TRC issues
  2. Model a baseline assessment for the wind integration study area footprint without new wind (5% reference case)
  3. Conduct detailed transmission planning analysis for the entire Eastern Interconnect for the 20% and 30% wind energy penetration scenarios
  4. Model two high renewable scenarios based on a 20% and 30% wind energy penetration in the study footprint analyzing wind integration within the wind integration study area footprint
  5. Model two variations based on the 20% wind and/or the 30% wind energy penetration scenario analyzing wind integration within the wind integration study area footprint to answer specific TRC issues
  6. Conduct effective load carrying capacity (ELCC) and loss of load probability (LOLP) analysis on four high penetration wind scenarios within the wind integration study area footprint
  7. Prepare Draft and Final Reports.

The New York Independent System Operator (NYISO) is a not-for-profit corporation that began operations in 1999. The NYISO operates New York's bulk electricity grid, administers the state's wholesale electricity markets, and provides comprehensive reliability planning for the state's bulk electricity system.

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