



# Predicting Power Delivery Capability

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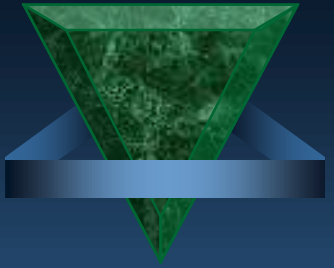
# What is PDC?

- ✓ ≠ Capacity
- ✓ Hourly Deliverable MW
- ✓ Gas Turbine PDC Varies with
  - Temperature
  - Relative Humidity
  - Atmospheric Pressure
  - Availability
  - Turbine Age / Cleanliness
  - Grid Congestion
  - Parasitic Load

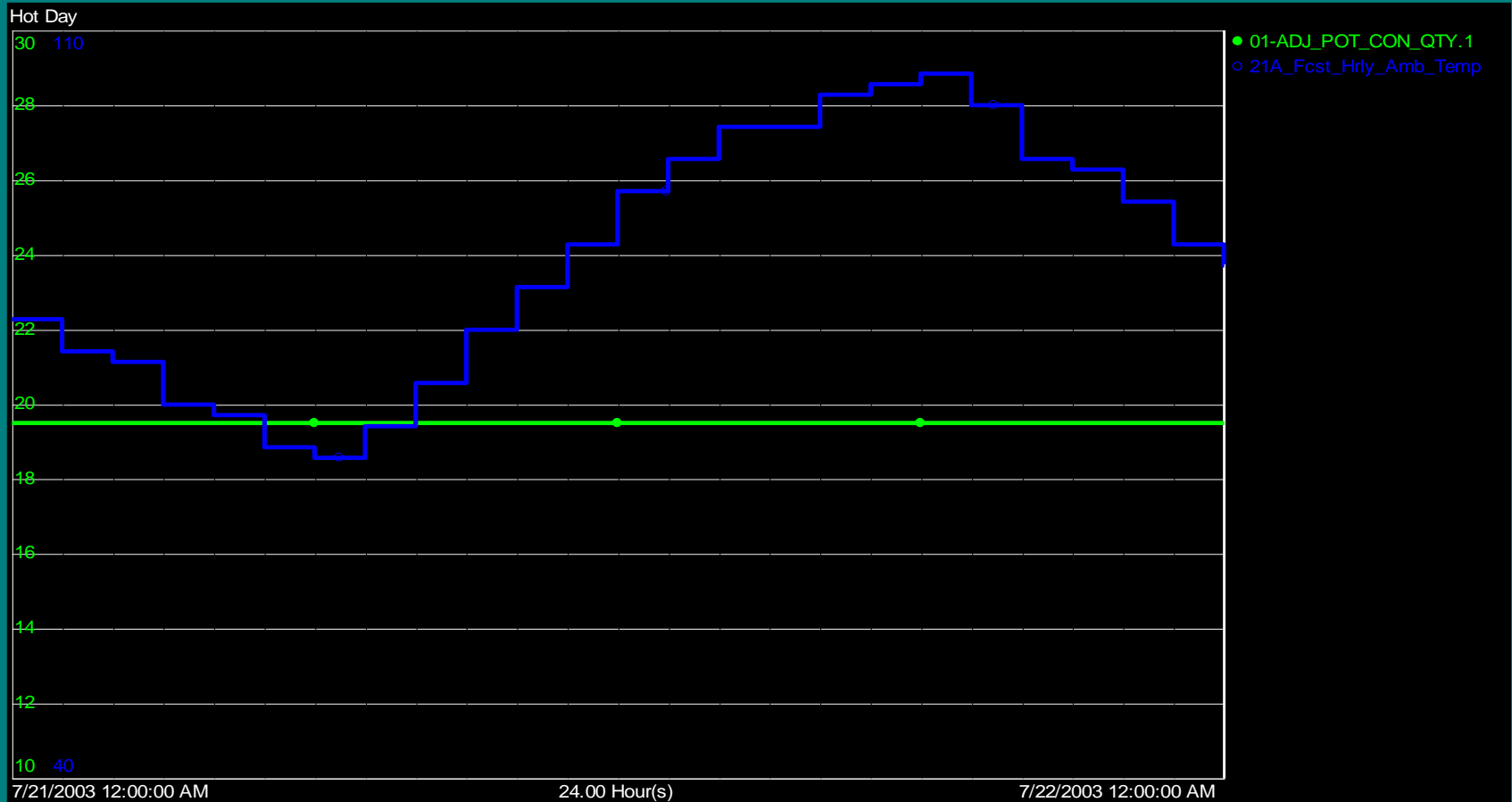


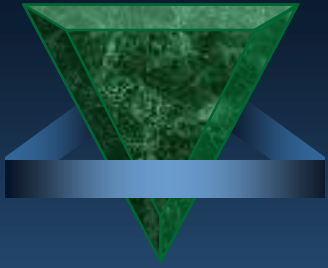
# GWF Background

- ✓ Independent Power Generator,  
Northern CA
- ✓ 10 Power Plants
  - 7 Steam QF's
  - 3 Gas Turbine
- ✓ Entered the Gas Turbine Peaker  
market in 2001

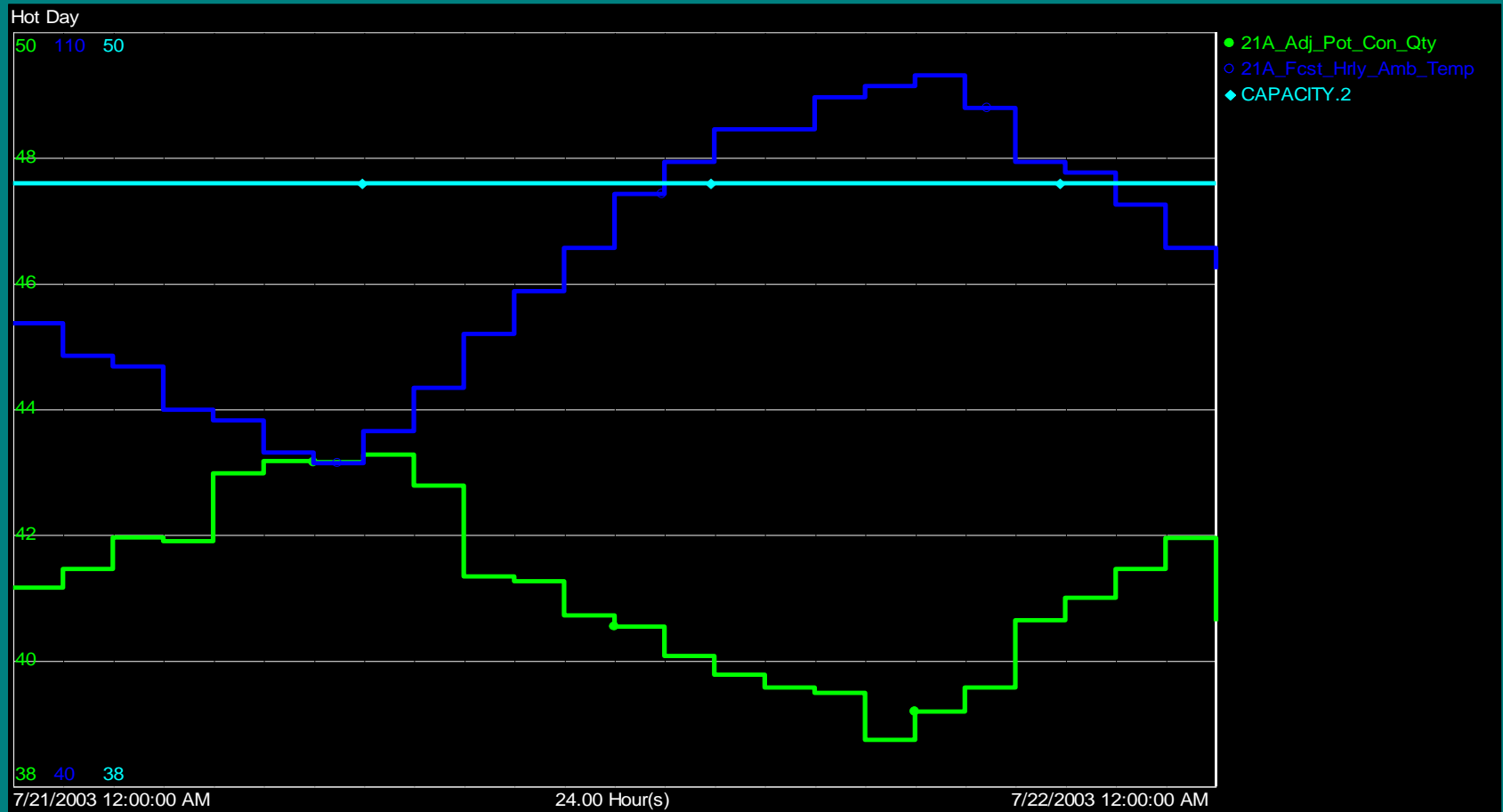


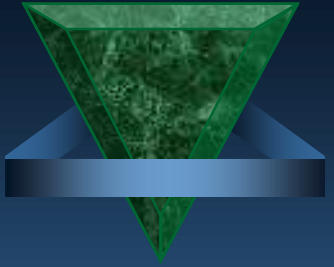
# How Much does PDC Vary in a Steam Turbine Power Plant?





# How Much does PDC Vary in a Gas Turbine Power Plant?





# Why does GWF Predict PDC?

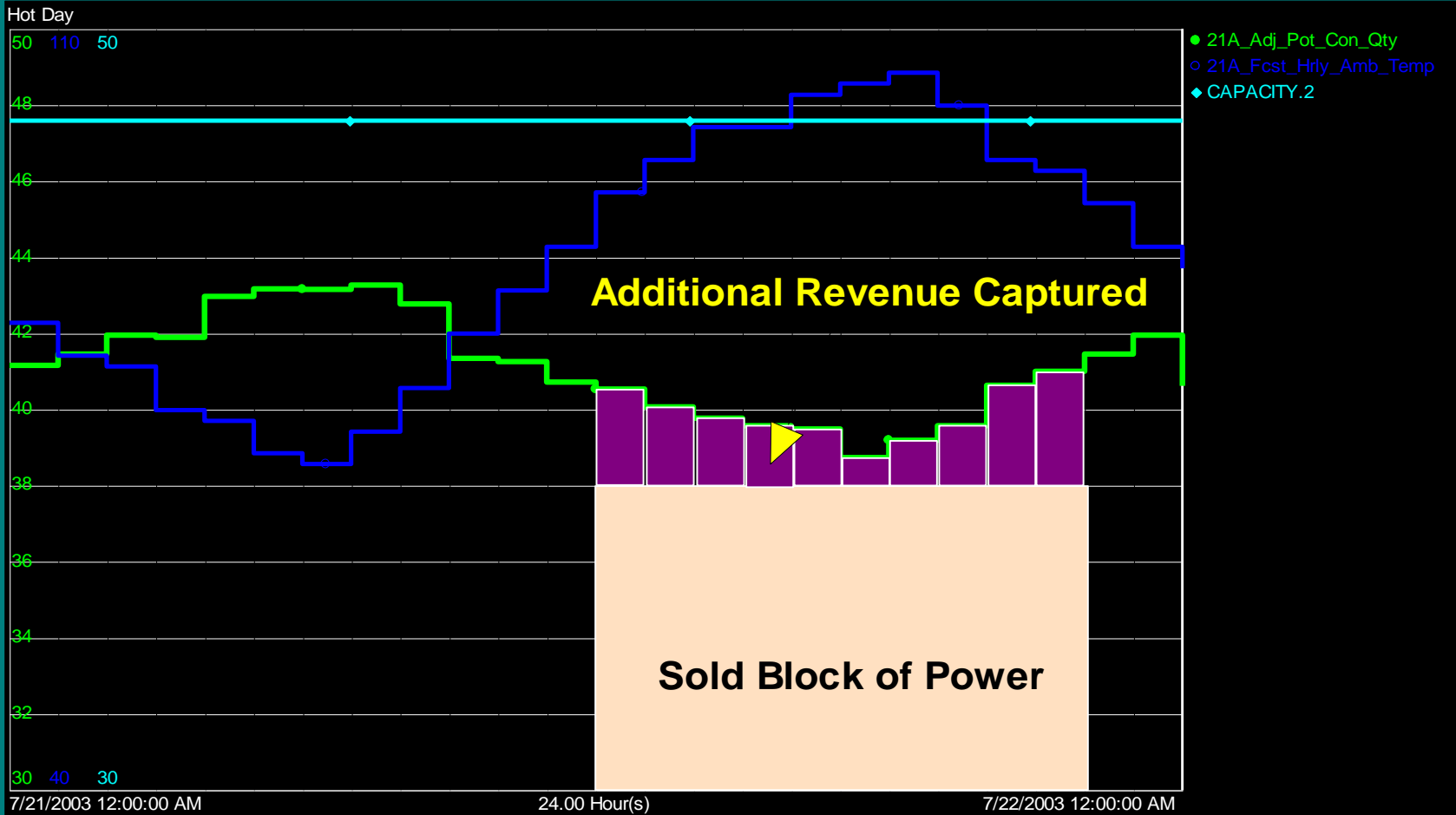
- ✔ Customer Requires It
- ✔ Maximize Return on Investment
- ✔ Minimize Market Exposure
- ✔ Diagnostic Tool
- ✔ Future CAISO Requirement  
(MD02)



# A Customer Requirement

- ✔ GWF recently added 362 MW Gas Turbine Generation Capacity.
- ✔ GWF communicates PDC 2-5 days in advance to allow for scheduling.
- ✔ GWF updates PDC in realtime.
- ✔ GWF avoided staffing a 24-hour scheduling desk by automation of the process.

# Maximizing Return on Investment / Minimizing Market Exposure







# A Diagnostic Tool

- ✔ Gas Turbine performance is predictable and widely understood, for a given set of conditions.
- ✔ Many variables impact performance.
- ✔ Predicting performance is extremely complicated, but already done for you.
- ✔ Comparing actual performance against predicted performance helps diagnose potential problems early.

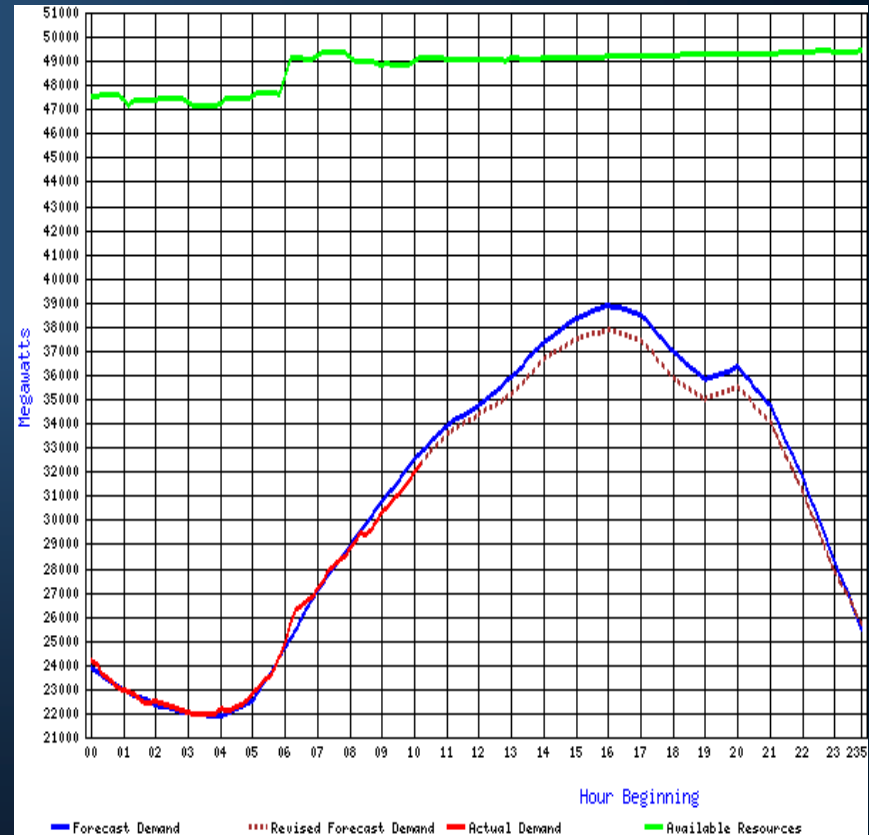


# Why T&D Might be Interested

- ✔ Gas Turbines represent 21.7% of WECC Generation Capacity  
(January 1, 2003)
- ✔ Nearly 100% of Planned Generation Capacity is Gas Turbine Based
- ✔ Gas Turbines projected to represent 43.3% of WECC Generation Capacity (December 31, 2012)
- ✔ Gas Turbine output is inversely proportional to ambient temperature

# Why T&D Might be Interested

- ✔ New Supply will be increasingly difficult to predict.
- ✔ Grid Management
  - Pinch Point at the Heat of the Day
  - Spot Supply Decay Early
  - Operate with more confidence in Reserve Margins
  - Transmission Congestion





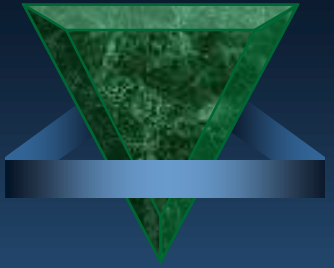
# How GWF Predicts PDC

- ✔ Forecast Weather, GMMs
- ✔ Actual Weather, GMMs
- ✔ Local Weather to GWF facility locations
- ✔ Turbine-specific Algorithms
- ✔ Capacity Tests
- ✔ Automatic Updates
- ✔ Communication to Customer



# Data Requirements

- ✓ Weather
  - Temperature
  - Relative Humidity
  - Atmospheric Pressure
- ✓ GMMs
- ✓ Availability
  - The only manual input



# Turbine-Specific Algorithms and Performance Testing

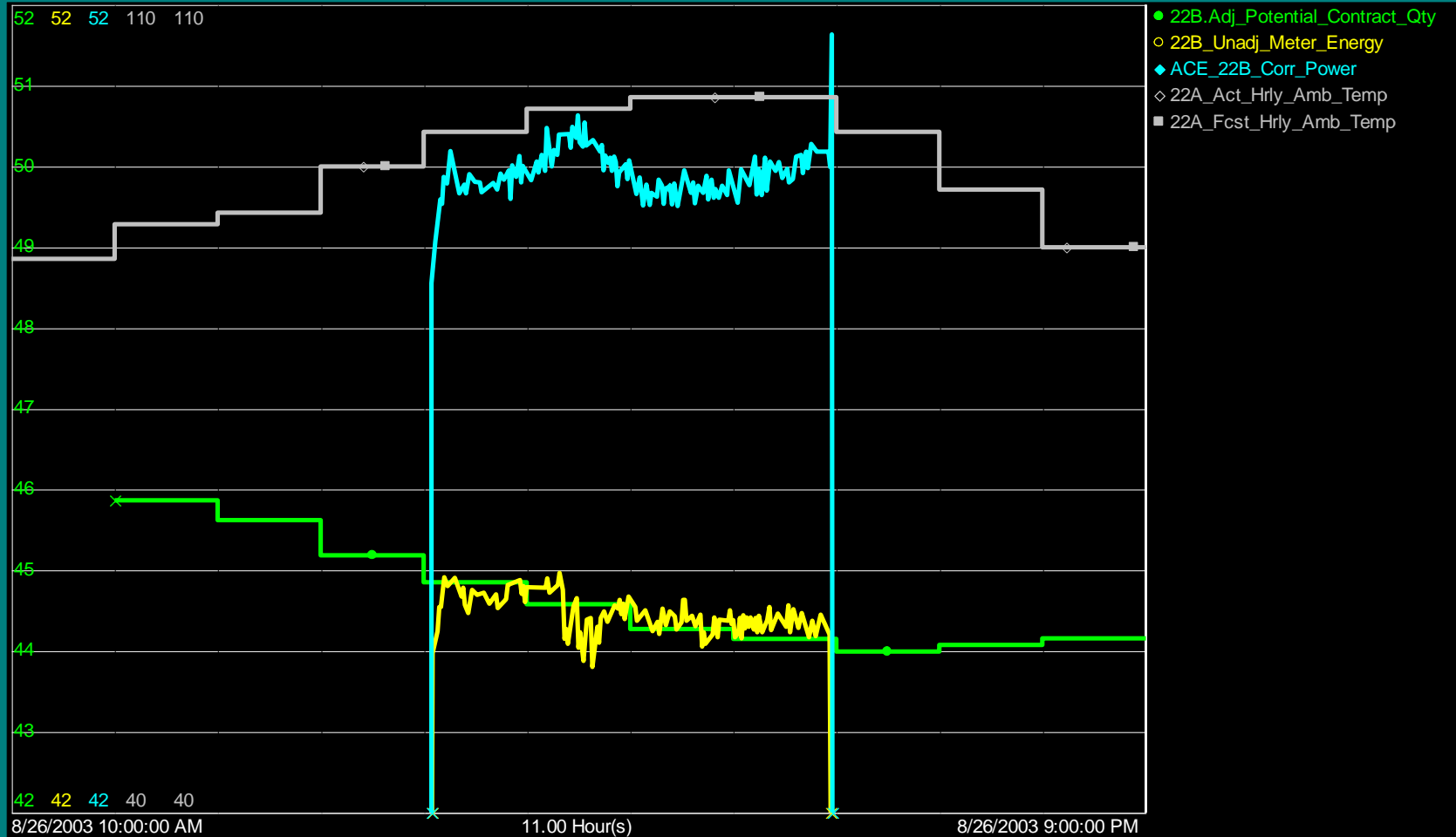
- ✓ Utilize Manufacturer's Correction Curves
- ✓ Inlet Conditioning must be modeled
- ✓ Incorporate annual Performance Test results to improve accuracy
- ✓ Actual parasitic load is measured



# Automation of the Process

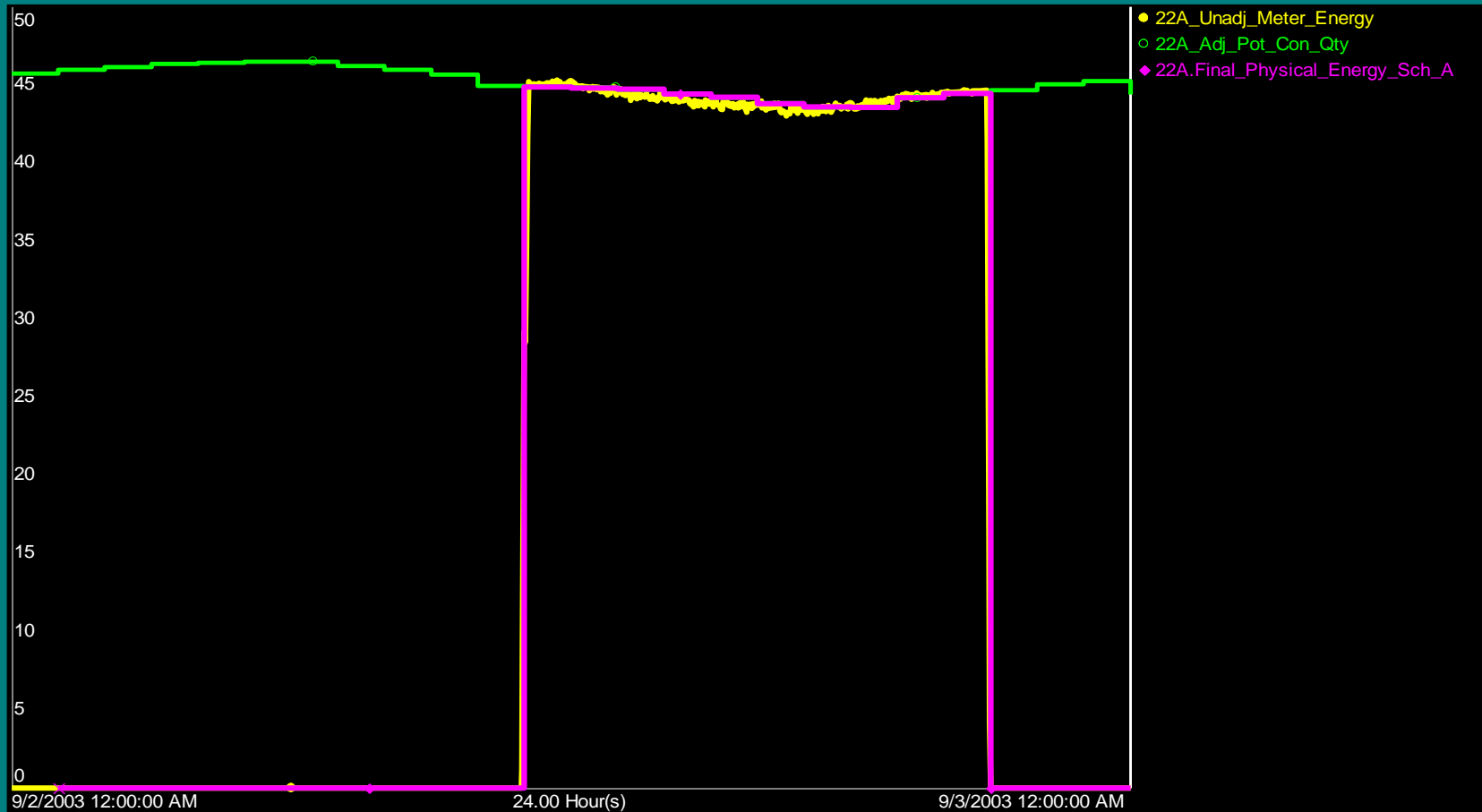
- ✔ Weather, GMMs, and Zonal Pricing retrieved via programmatic download from the internet
- ✔ Forecasts and PDC calculations are stored in a SQL Server database, then written to PI by ACE
- ✔ Control Room Operator enters any Unit Derations
- ✔ Availability Notice automatically emailed to customer

# How Accurate?





# Production Schedules are Clearly Communicated to Operators





## New Value in PI

- ✔ Spot problems early by realtime comparison of predicted vs. actual performance
- ✔ Meet production targets better by displaying schedules and actual performance together
- ✔ Analyze data faster due to common location and format of multiple data sources
- ✔ Easily retrieve data for invoice generation



# Automating the Downloads of OASIS Reports.

- ✓ Peter A. Knudson
  - PAKsoft
  - [www.PAKsoft.com](http://www.PAKsoft.com)
  - Peter@PAKsw.com



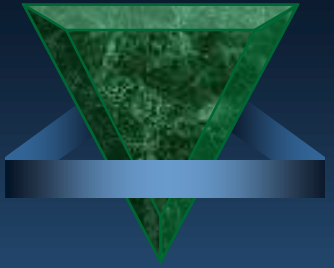
# Bio

- PAKsoft is a contract software development company specializing in developing windows applications using OSIsoft's products.
- Including PI SDK/API applications, ProcessBook displays, ACE modules, ActiveX control development. .Net (C#), Visual Basic, C++, VBA, ATL com.
- An OSIsoft business partner.
- Twenty years of software development experience. Fifteen years of experience developing software applications for the electric utility industry.
- [Peter@PAKsw.com](mailto:Peter@PAKsw.com)
- [www.PAKsoft.com](http://www.PAKsoft.com)
- (425) 246-9310



# Goals

- ✓ Hands off, worry free retrieval of data reports.
- ✓ Allows you to concentrate on the applications you want to develop, knowing that the reports/data have been retrieved.
- ✓ You don't waste your time manually retrieving the reports.



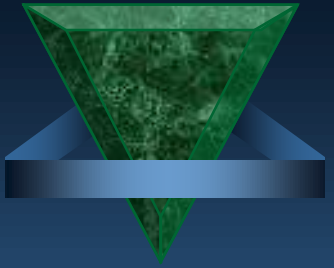
# Process in a Nutshell

- ✓ Assemble a query string.
- ✓ Use WinInet.
  - InternetOpen, InternetOpenURL, InternetReadFile.
- ✓ Or MS Internet transfer control.
- ✓ Receive file as a .zip. Extract .xml file from the .zip.
- ✓ Extract data from the .xml file.
- ✓ Write data to PI. (if future data to a relational DB).



# Which Reports Can Be Programmatically Downloaded.

- ✓ Any report that can be done manually.
- ✓ Reports that have been automated include:
  - Ex-Post:
    - Inc.
    - Dec.
  - Forecasts Unit Generation Meter Multipliers.
  - Actual GMMs.




# Requirements

- ✔ PI
- ✔ PI SDK/API.
- ✔ WinZip (with command line utility).
- ✔ Application should be installed on a computer that will be normally left on. (can't run if the computer isn't on).
- ✔ Computer needs to be connected to the internet.



# XML File



```
C:\PAKSoft\Presentation\New Folder\20030911_20030913_EXP_10MIN_PRC_N_N.xml - Mic...
File Edit View Favorites Tools Help
Back Forward Stop Refresh Home Search Favorites Media History
Address C:\PAKSoft\Presentation\New Folder\20030911_20030913_EXP_10MIN_PRC_N_N.xml Go Links
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</DATA>
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  <DATA_ITEM>EXP_10MIN_INC_PRC</DATA_ITEM>
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  </DATA>
Done My Computer
```

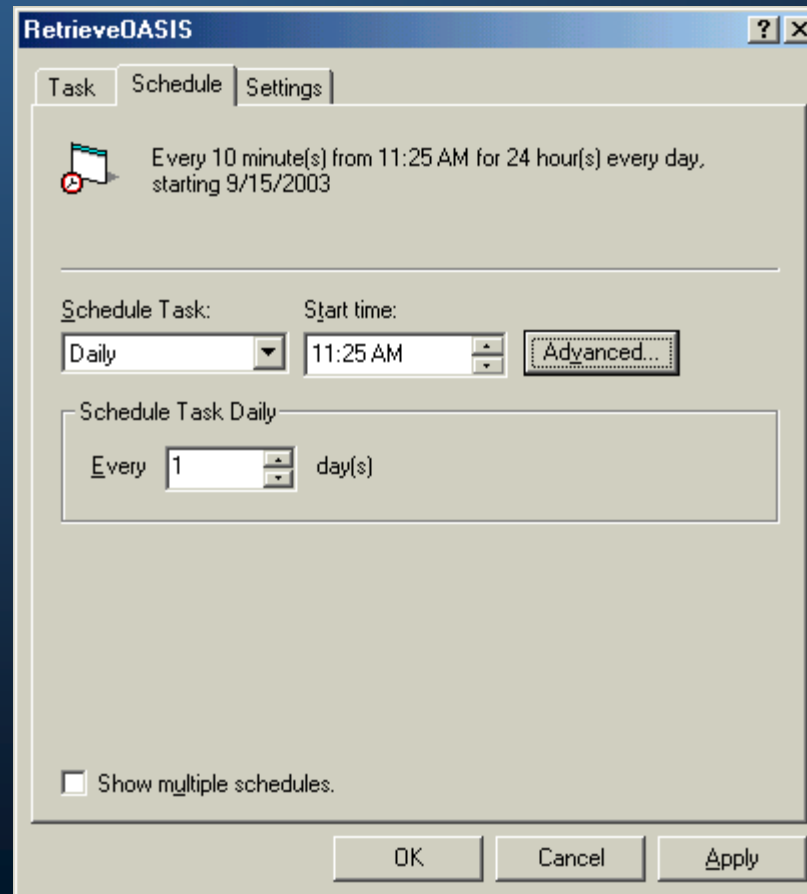


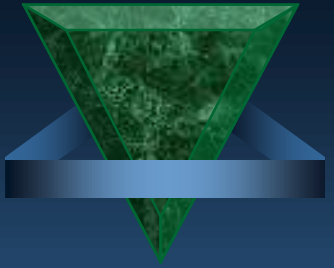
# Options for Periodically Running the Report Retrieval.

- ✔ NT Service.
- ✔ Constantly running program (7x24), with built in timer mechanism.
- ✔ ACE module (clock scheduled).
- ✔ Application which is designed to be launched via MS Scheduled Tasks.

# Microsoft Scheduled Tasks

- ✓ Most difficult aspect of MS Scheduled Tasks is locating it.
  - Start-> Programs->Accessories -> System Tools -> Scheduled Tasks.





# Application Features

- ✔ Auto-clean-up.
  - Automatically, deletes zip and xml files when finished with them.
- ✔ Allows, user to “manually” run a report whenever needed.
- ✔ Message logging.
  - Including description and error numbers for any unexpected occurrences.
  - Auto clean of message log file.



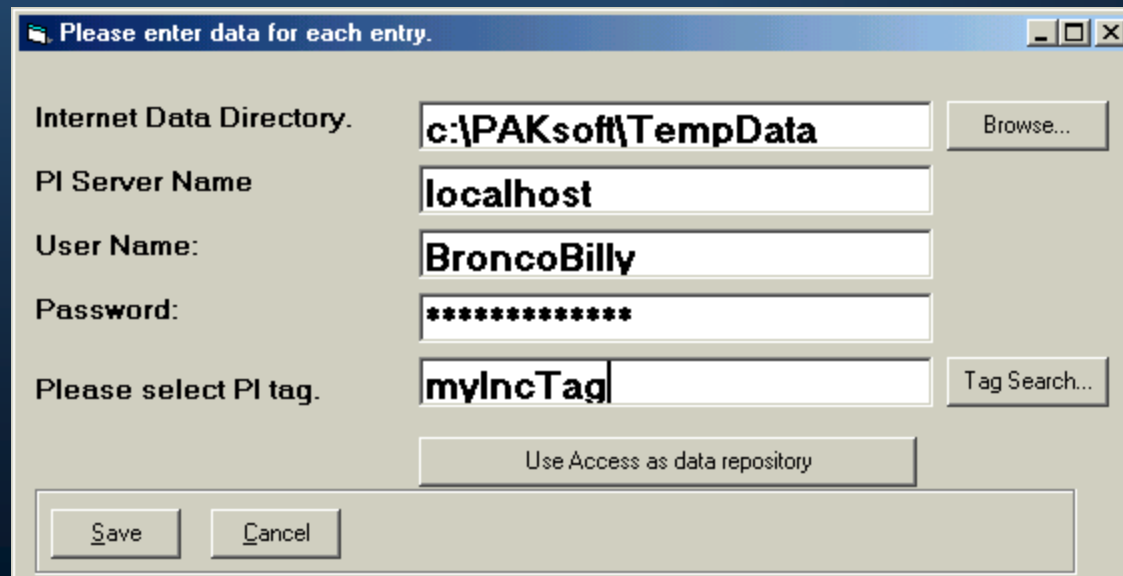
# Additional Features

- ✔ Can request that xml and zip files are not deleted for a run.
  - Simply, run app. and select the “Do Not Delete” button.
  - Useful, if raw data is desired for any reason. One time use in a spreadsheet for example.
- ✔ During application setup can select to use Access as DB.
- ✔ Shipped with sample spreadsheet that can be used to create PI tags (via SMT export).



# Application Inputs

- ✓ Utility program is used (normally just once) to set up all necessary inputs for the application.
- ✓ These settings saved to .ini, .xml file, or the registry.

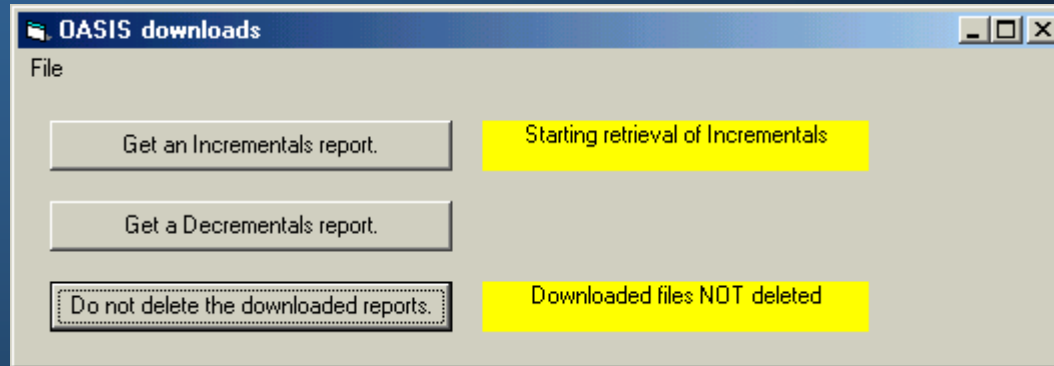


The screenshot shows a Windows-style dialog box with the title "Please enter data for each entry." and standard window controls (minimize, maximize, close). The dialog contains the following fields and buttons:

- Internet Data Directory:** A text box containing "c:\PAKsoft\TempData" and a "Browse..." button to its right.
- PI Server Name:** A text box containing "localhost".
- User Name:** A text box containing "BroncoBilly".
- Password:** A text box containing "\*\*\*\*\*".
- Please select PI tag:** A text box containing "myIncTag" and a "Tag Search..." button to its right.
- Use Access as data repository:** A button located below the "Please select PI tag" field.
- Save** and **Cancel** buttons are located at the bottom of the dialog.



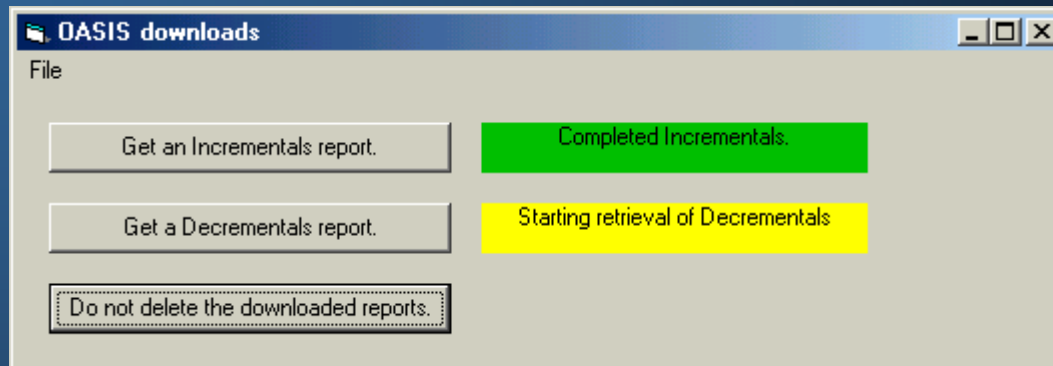
# Application During Run



- ✓ In this example the user has requested that the files not be deleted.
- ✓ The application shows that the Incs have begun to be retrieved.

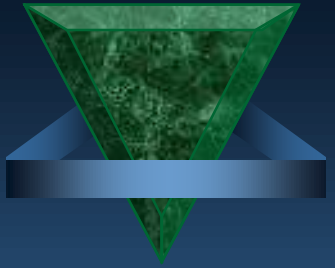


# Application Running



- ✓ The Incs have been retrieved. The Decs have begun.
- ✓ This view would be similar to when launched via scheduled tasks (downloaded files are going to be auto deleted.)





# “Genericizing” the Application

- ✓ Supply an “off-the-shelf” application which can be used for the purpose of automated report downloads.
- ✓ Select type of report desired.
  - Inc or Dec then
    - Select Zone from list of available zones.
      - NP15, SP15, etc.
  - GMMs
    - Forecast or Actuals.
    - Select Resource Point
      - ZOND\_6\_UNIT, etc.



## Other

- ✓ DST (Daylight Savings Time).
  - Accommodate null hour in spring.
  - Accommodate 25<sup>th</sup> hour last Sunday of October. 25<sup>th</sup> hour represents the second 0200 hour.
- ✓ Use with firewalls. Has not been a problem uses standard internet port.
  - Other types of data downloads (not OASIS reports) retrieved via FTP, I have had to “tell” the firewall about the application.