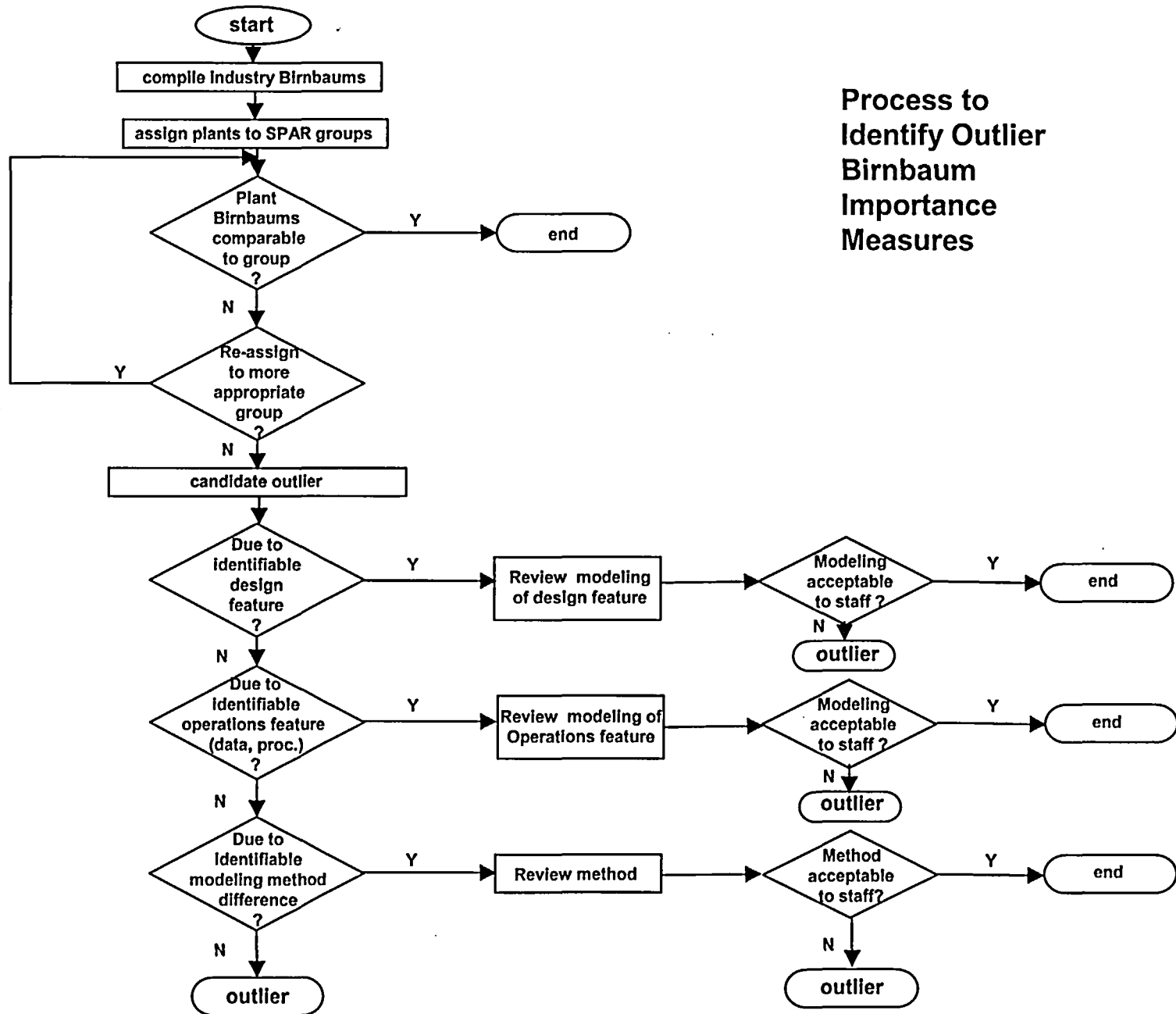


Mitigating Systems Performance Index Plant Comparison Database Process and Examples

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July 20, 2005**



Process to Identify Outlier Birnbaum Importance Measures

Status

- Industry Birnbaum Data
 - Received data representative of all 103 units
 - 85% of major component basic events (BEs) have been matched with their associated SPAR BEs and entered into the MSPI database (1574 records)
 - Approximately 300 records currently do not match due to SPAR model truncation or limitation
 - Approximately 40 records were reported as being below truncation by the industry

Emergency AC

- 3 preliminary EAC groups
 - Groups address both BWRs and PWRs
- Groups
 - EDG Capability/Score ≤ 2
 - EDG Capability/Score 2 to 3
 - EDG Capability/Score >3

Capability: Evaluated at the plant level and considers the total number of AC sources including alternate AC and cross-ties.

Score: Evaluated at the component level and considers function and configuration including the availability of backup power sources.

Heat Removal

- PWRs
 - 3 preliminary AFW/EFW MDP groups
 - Groups are based on the electrical bus relationship between the motor-driven pump and the TDPs/PORVs.
 - 2 preliminary AFW/EFW TDP groups
 - Plants with a single TDP (all PWRs)
 - Plants with multiple TDPs (including DDPs or dedicated safe shutdown diesel MDPs)
- BWRs
 - under development

High Pressure Injection

- PWRs
 - 4 preliminary HPI groups – group refinement is in progress
 - Plants with 2 HPSI pumps or 3 HPSI pumps where one is treated as an installed spare (does not include the install spare)
 - Plants with 3 or more HPSI pumps (equally treated)
 - Plants with 3 or more HPSI pumps (with asymmetry)
 - Pumps that are modeled as installed spares
- BWRs
 - under development

Residual Heat Removal

- PWRs
 - 2 preliminary RHR MDP groups
 - Plants with two RHR pumps that provide suction to HPI pumps during recirculation
 - Remaining plants – includes all CE plants and the balance of other plants where RHR pumps don't support the recirculation
- BWRs
 - under development

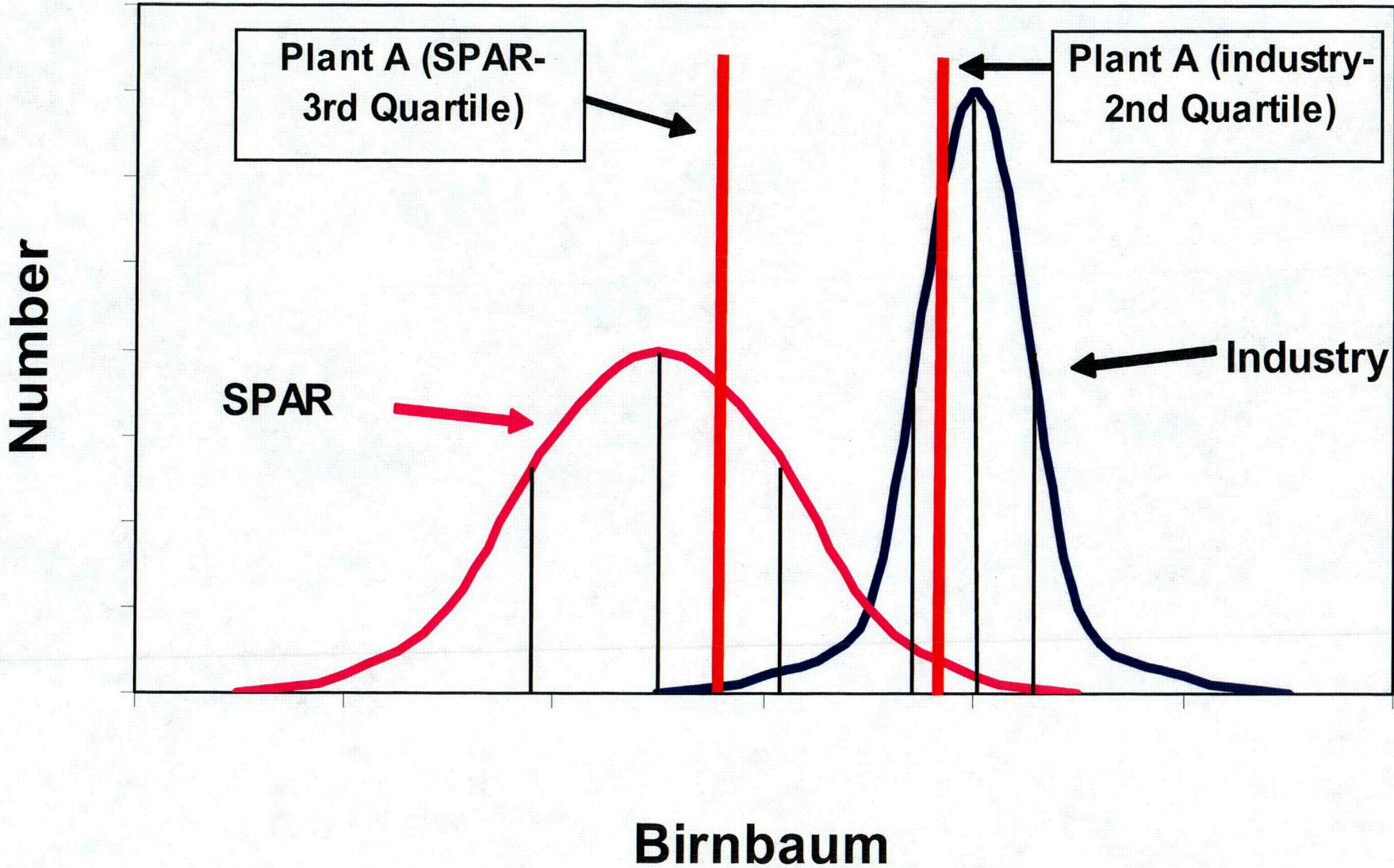
Cooling Water

- PWRs
 - SPAR cutsets for all cooling water pumps have been reviewed and characterized (approximately 350 pumps)
 - Preliminary grouping developed – group refinement in progress
 - Pump configuration, RCP seal type, function and available recoveries have been found to be important
 - Typical functions include cooling for: RCP Seals, HPI pumps, EDGs, RHR heat exchangers, AFW room, SWGR
 - An approach is being developed to adjust SPAR CW BEs to reflect the IE contribution.
- BWRs
 - under development

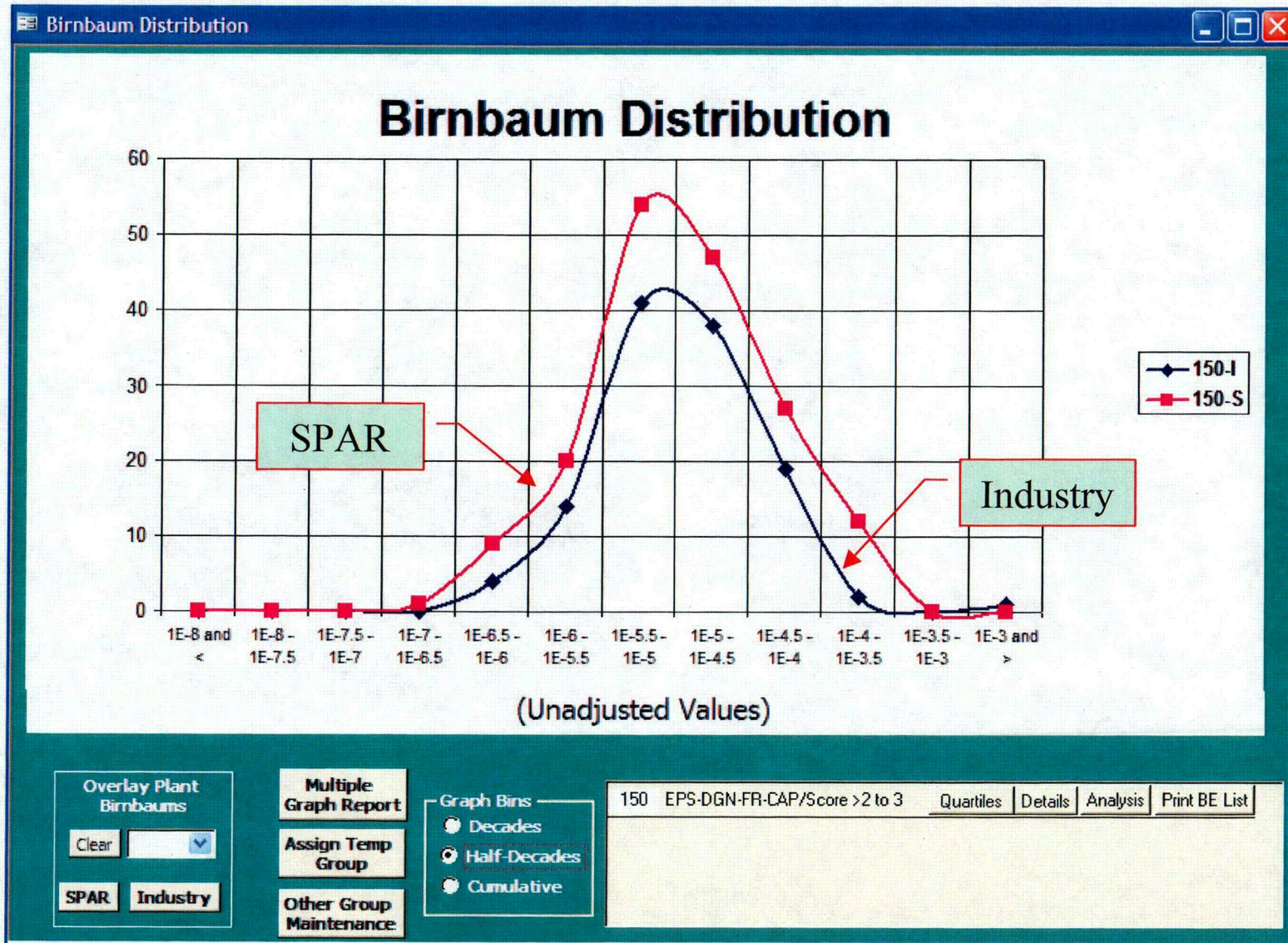
Birnbaum Differences

- **Can be substantial differences in Birnbaum distributions between SPAR models and industry values**
 - Differences in modeling and performance data
 - Differences in model completeness for SPAR
 - Differences in accounting for support system initiator contribution to Birnbaum (SPAR does not directly)
- **Rank-order differences based on relative location of plant values within group (by quartile)**
 - $RANK = [SPAR \text{ quartile}] \text{ minus } [industry \text{ quartile}]$
 - Largest differences are highest candidate outliers for review
 - e.g., SPAR 4th quartile, industry 1st quartile

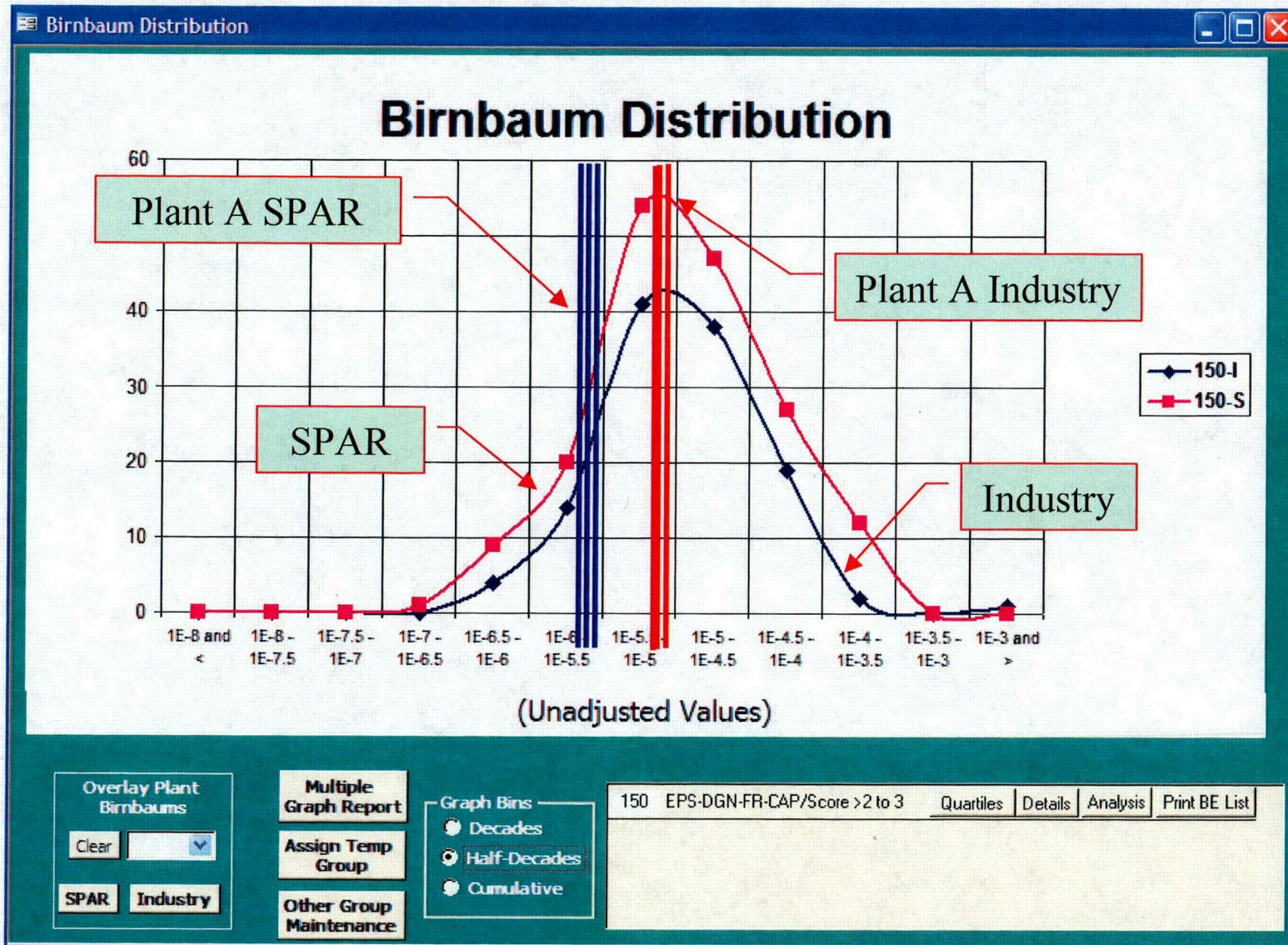
Birnbaum Distribution w Quartiles



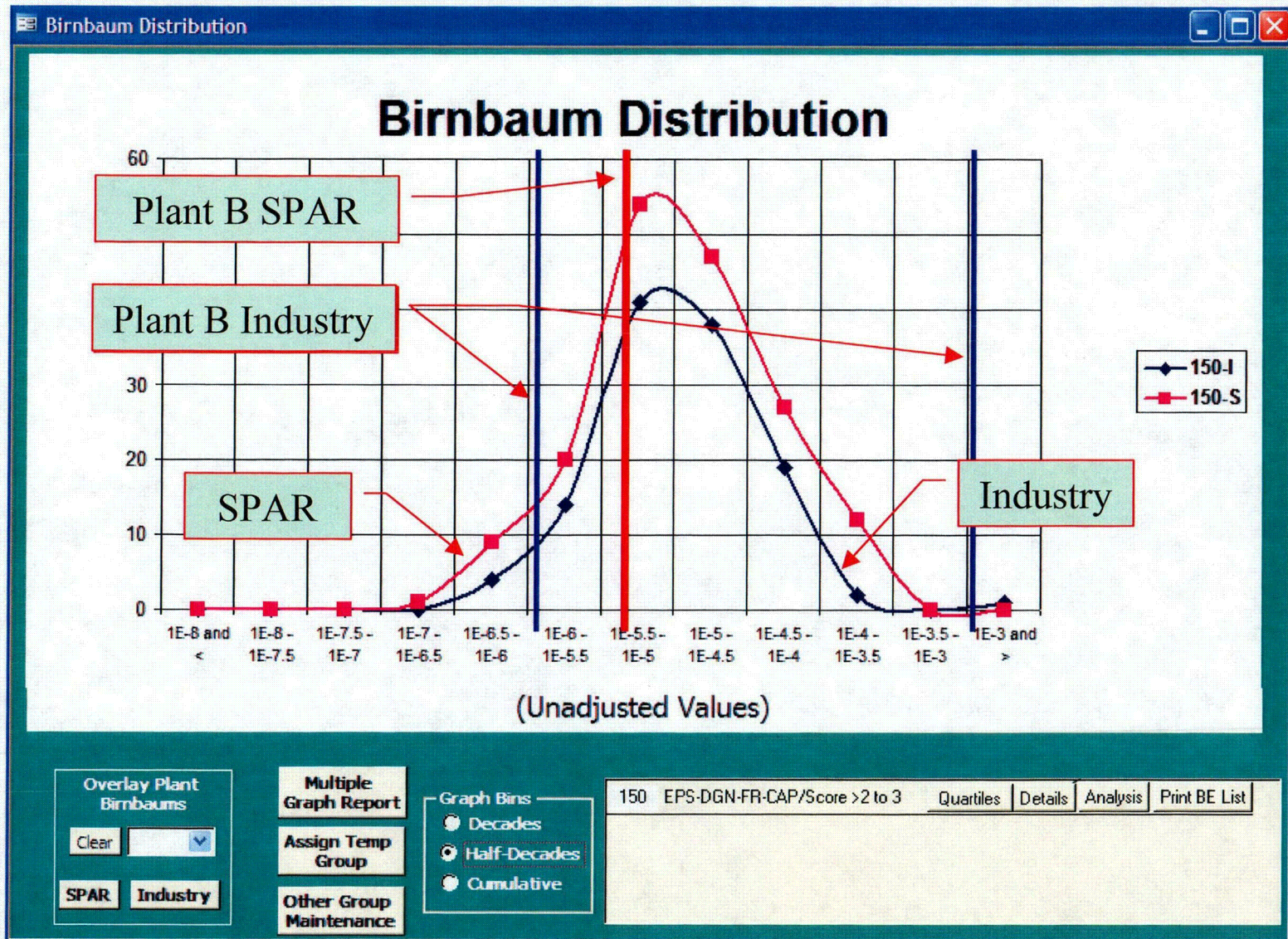
Electrical Generators - Grouped Capability/Score >2 - 3



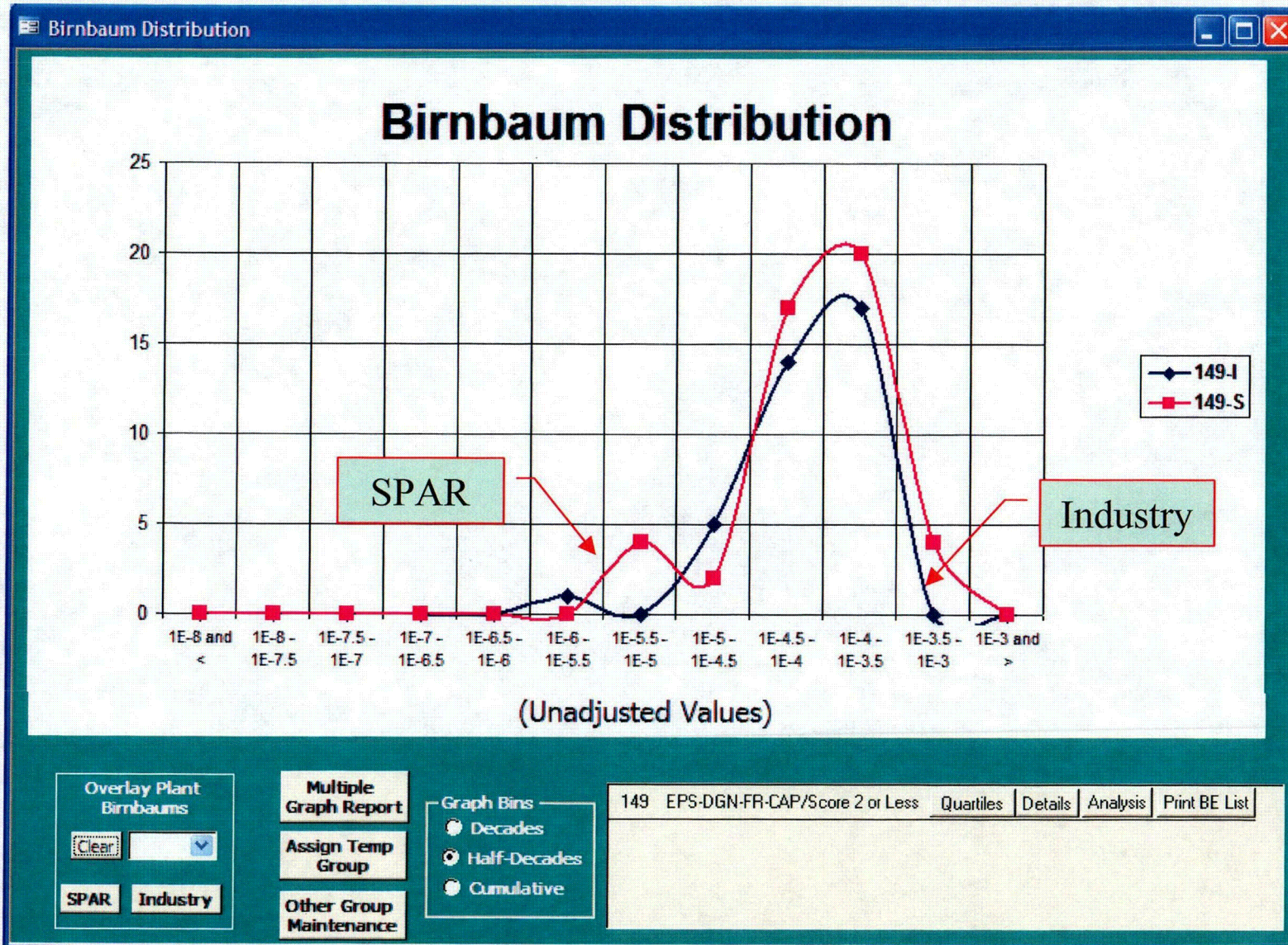
Electrical Generators - Grouped Capability/Score >2 - 3



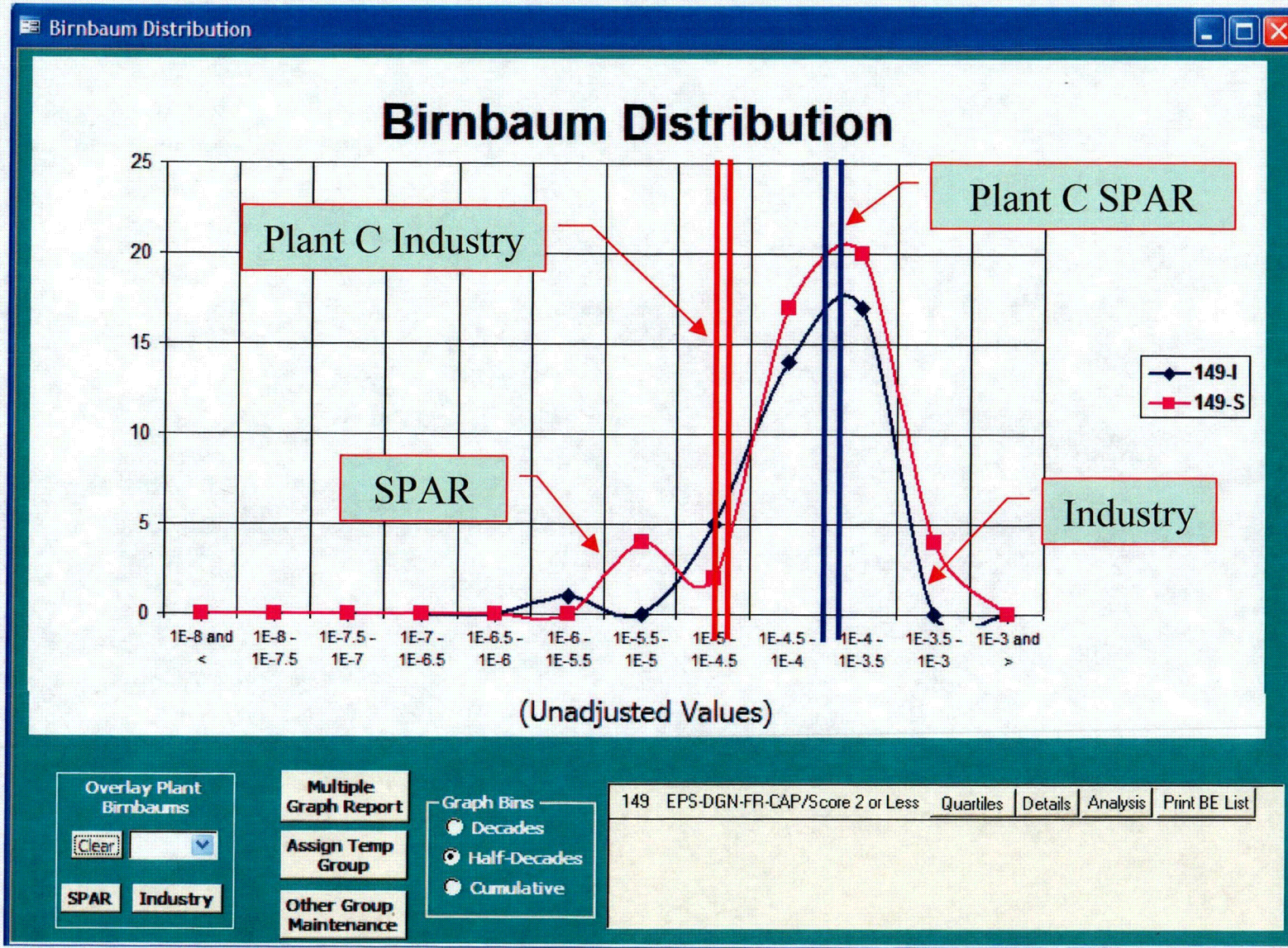
Electrical Generators - Grouped Capability/Score >2 - 3



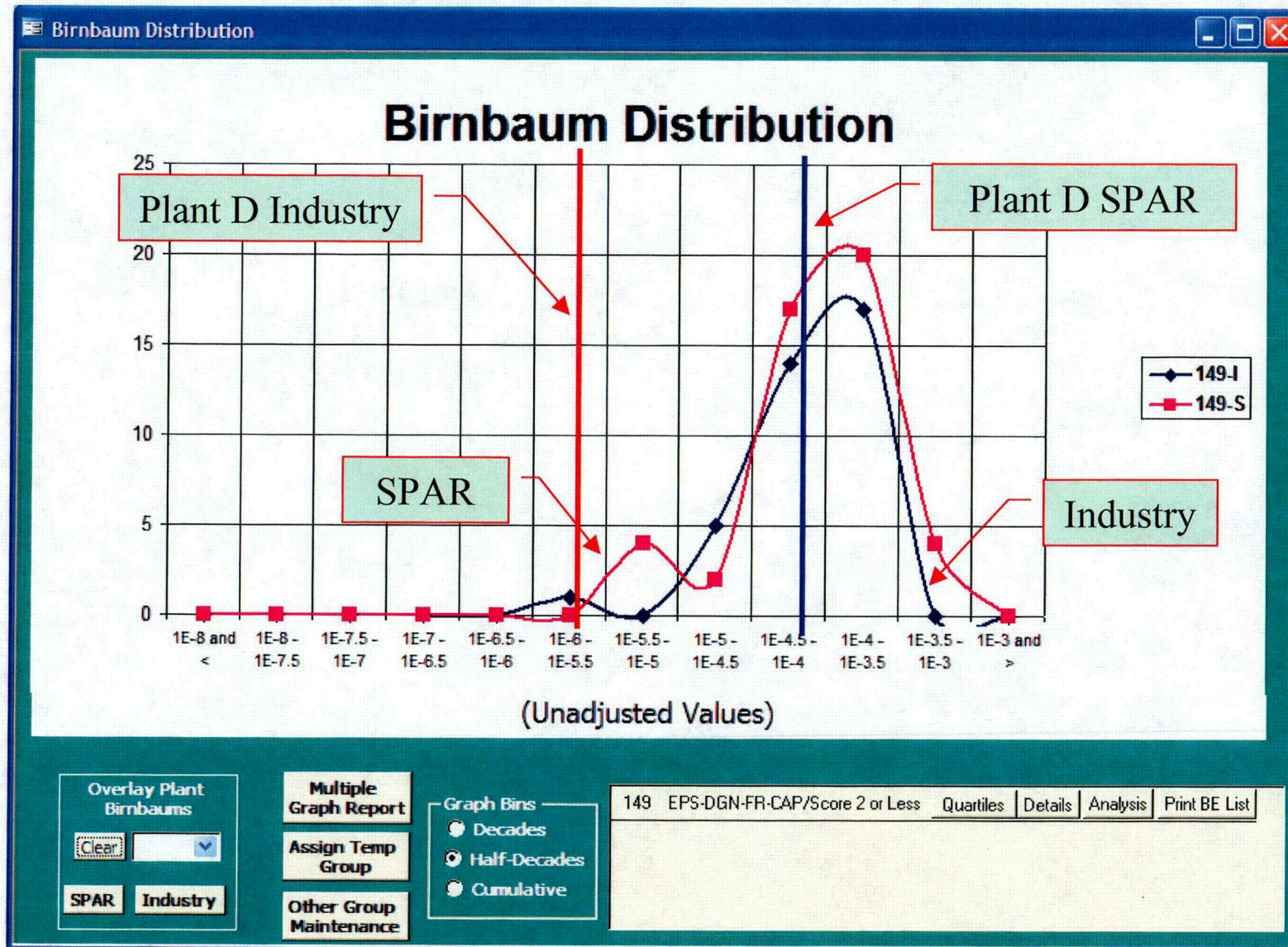
Electrical Generators - Grouped Capability/Score ≤ 2



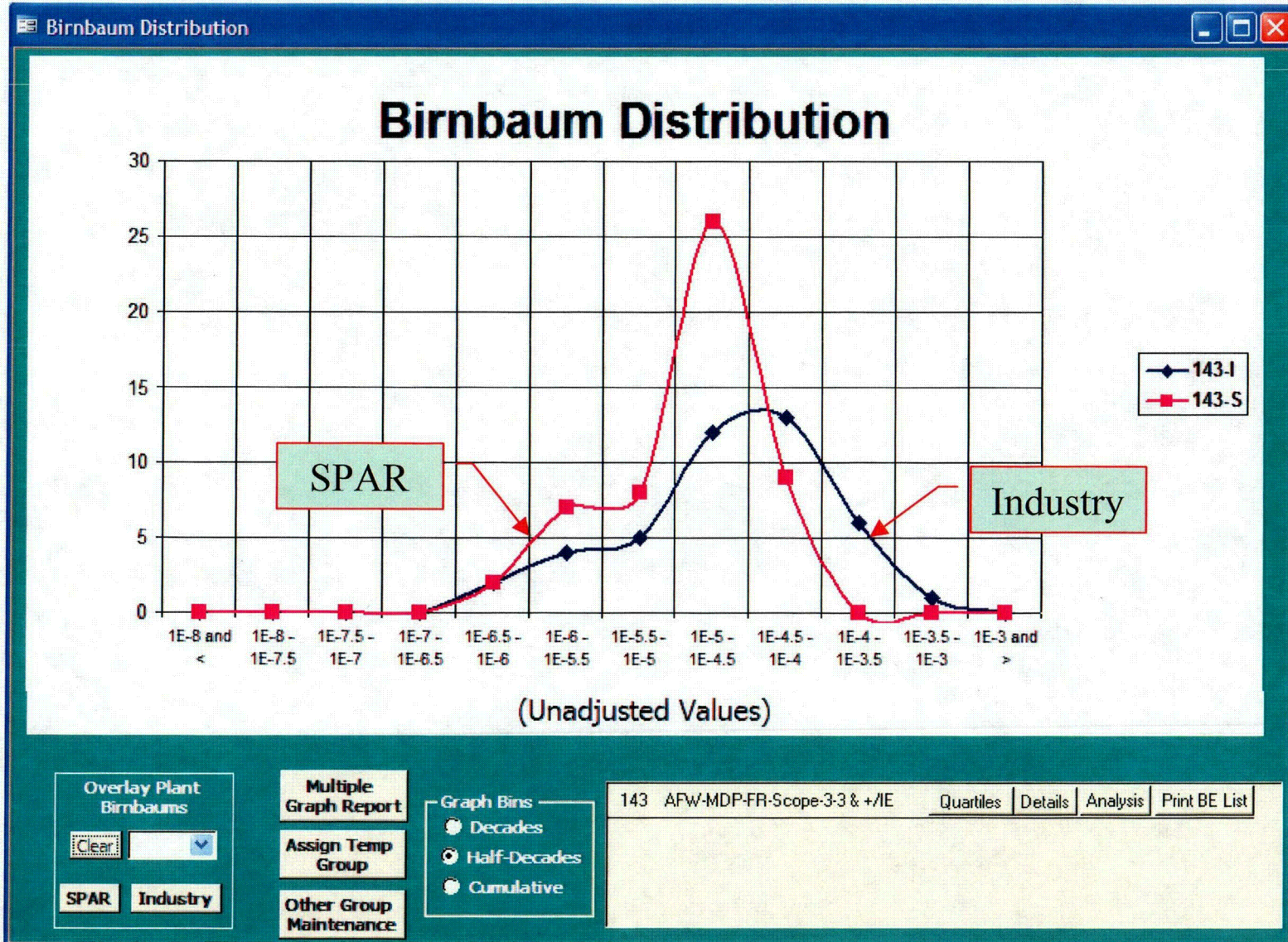
Electrical Generators - Grouped Capability/Score ≤ 2



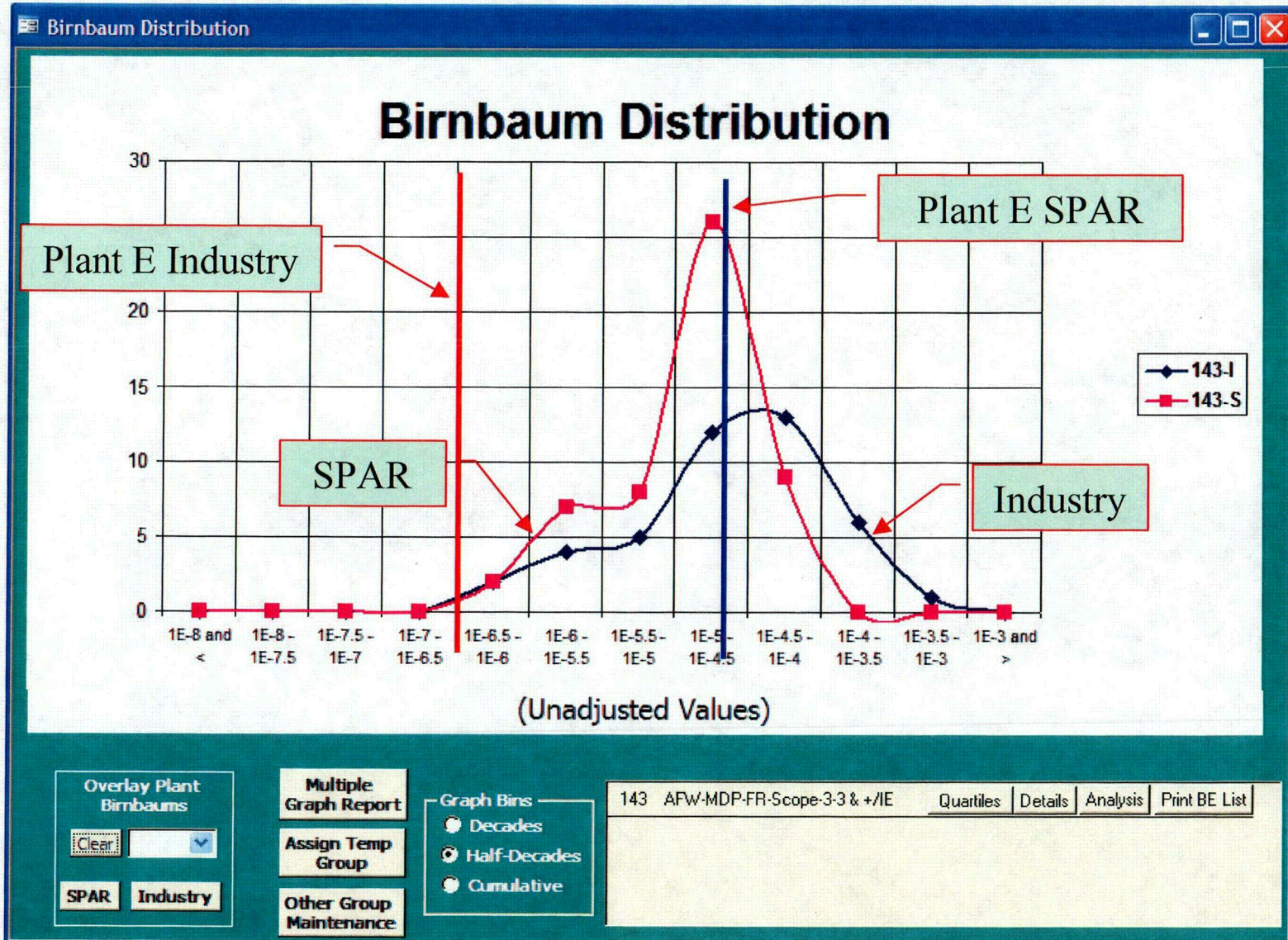
Electrical Generators - Grouped Capability/Score ≤ 2



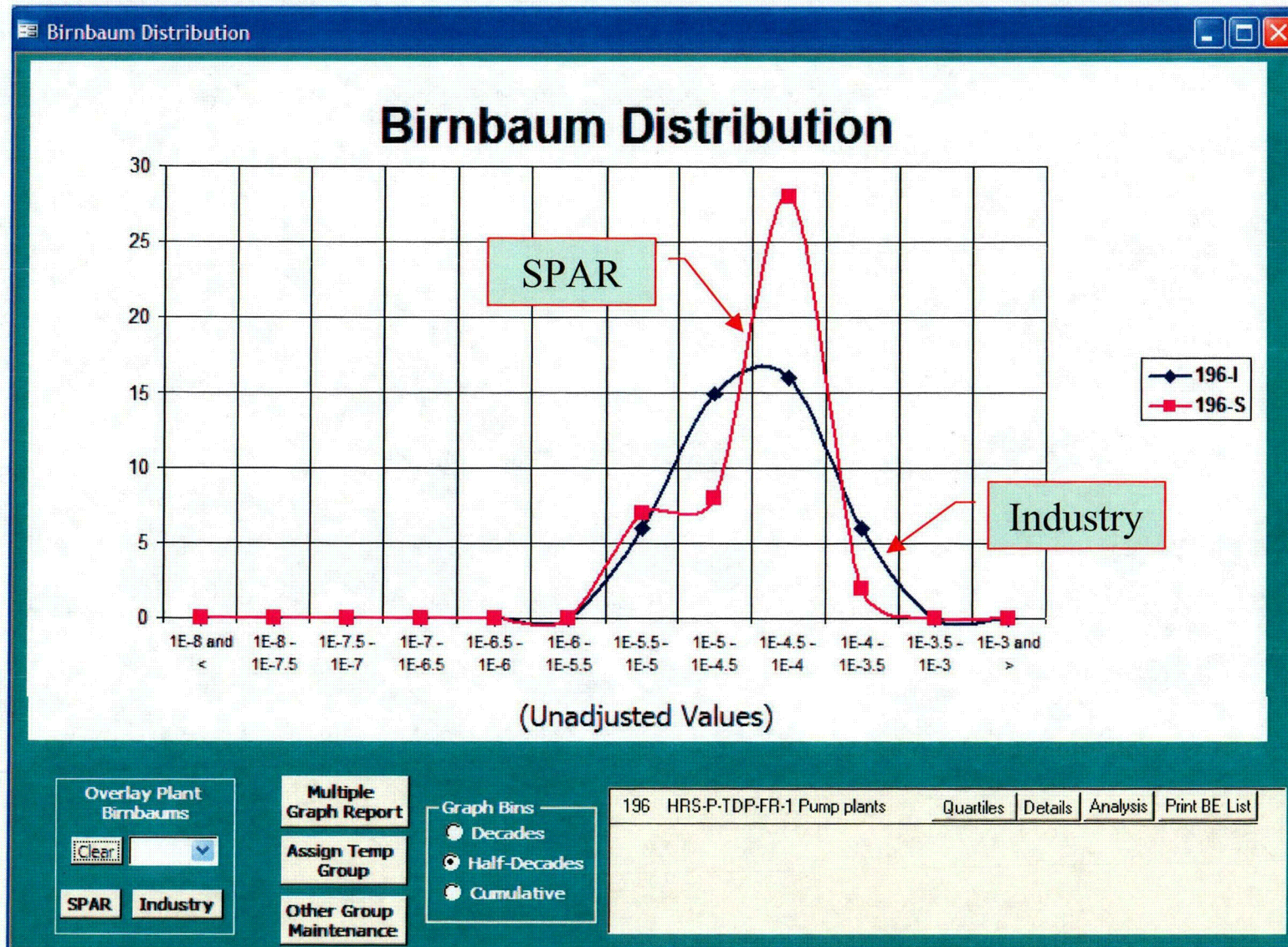
AFW- MDPs with Power Separation from TDP/PORV



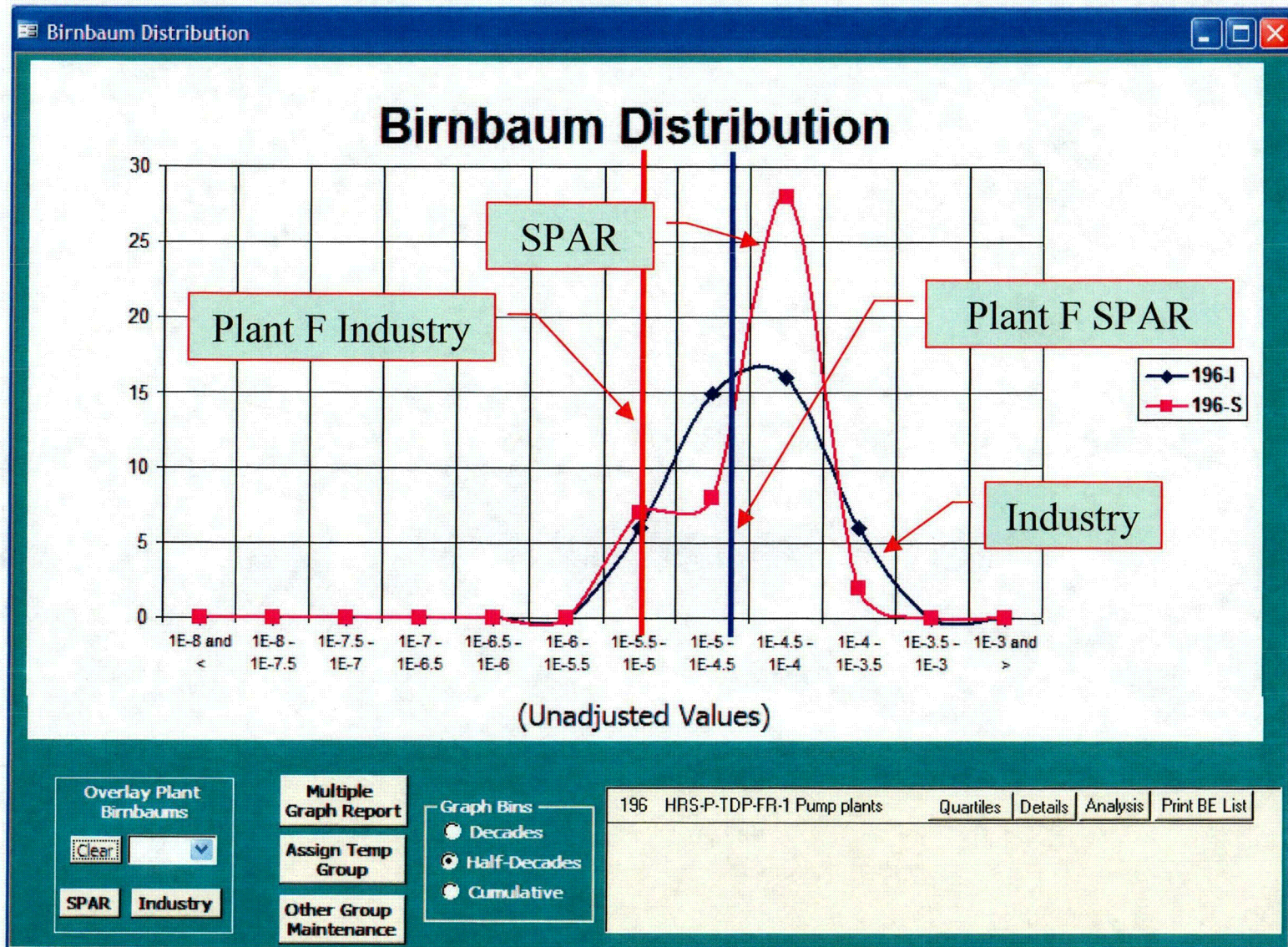
AFW- MDPs with Power Separation from TDP/PORV



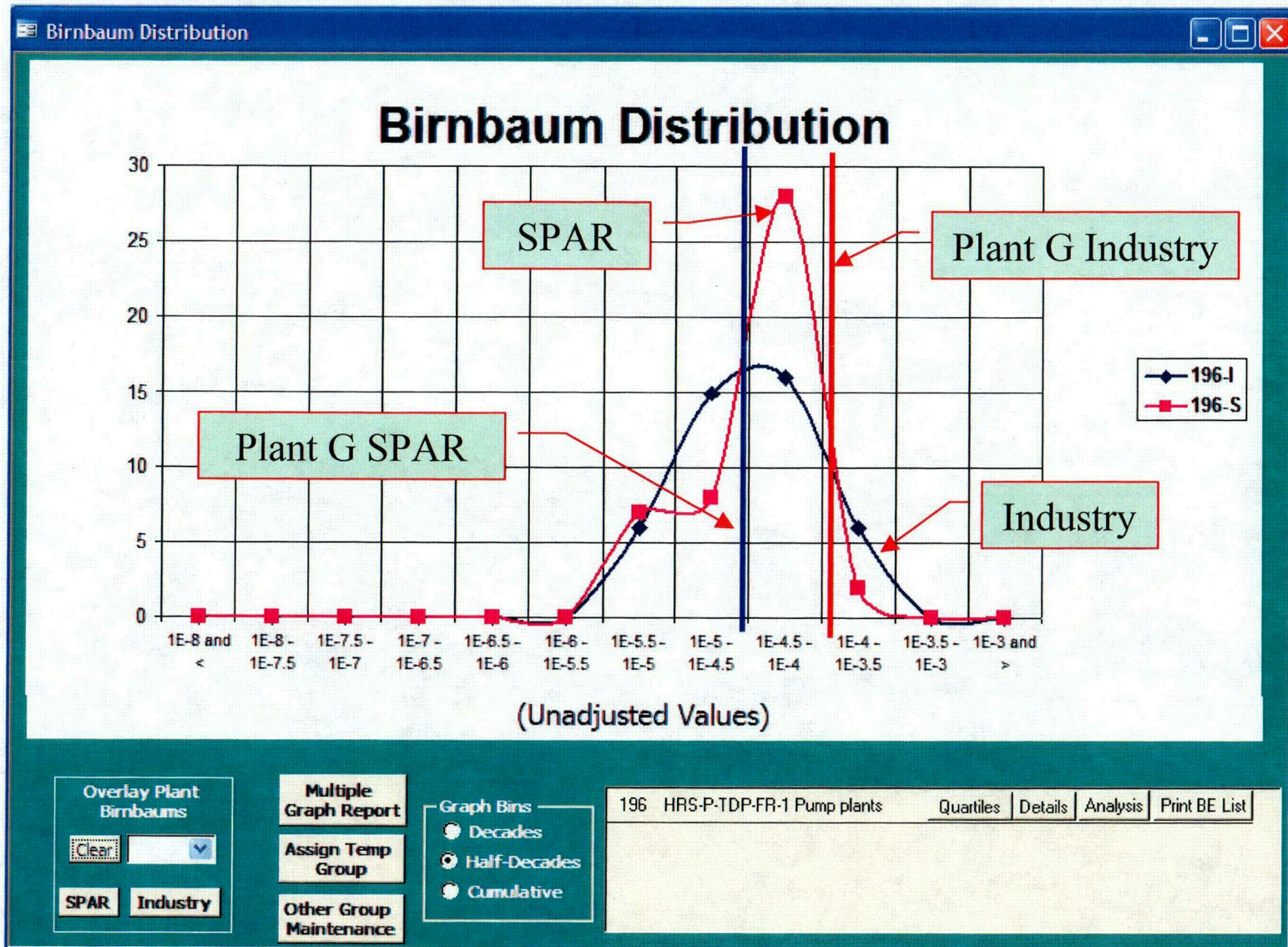
AFW- TDPs – Plants with One TDP



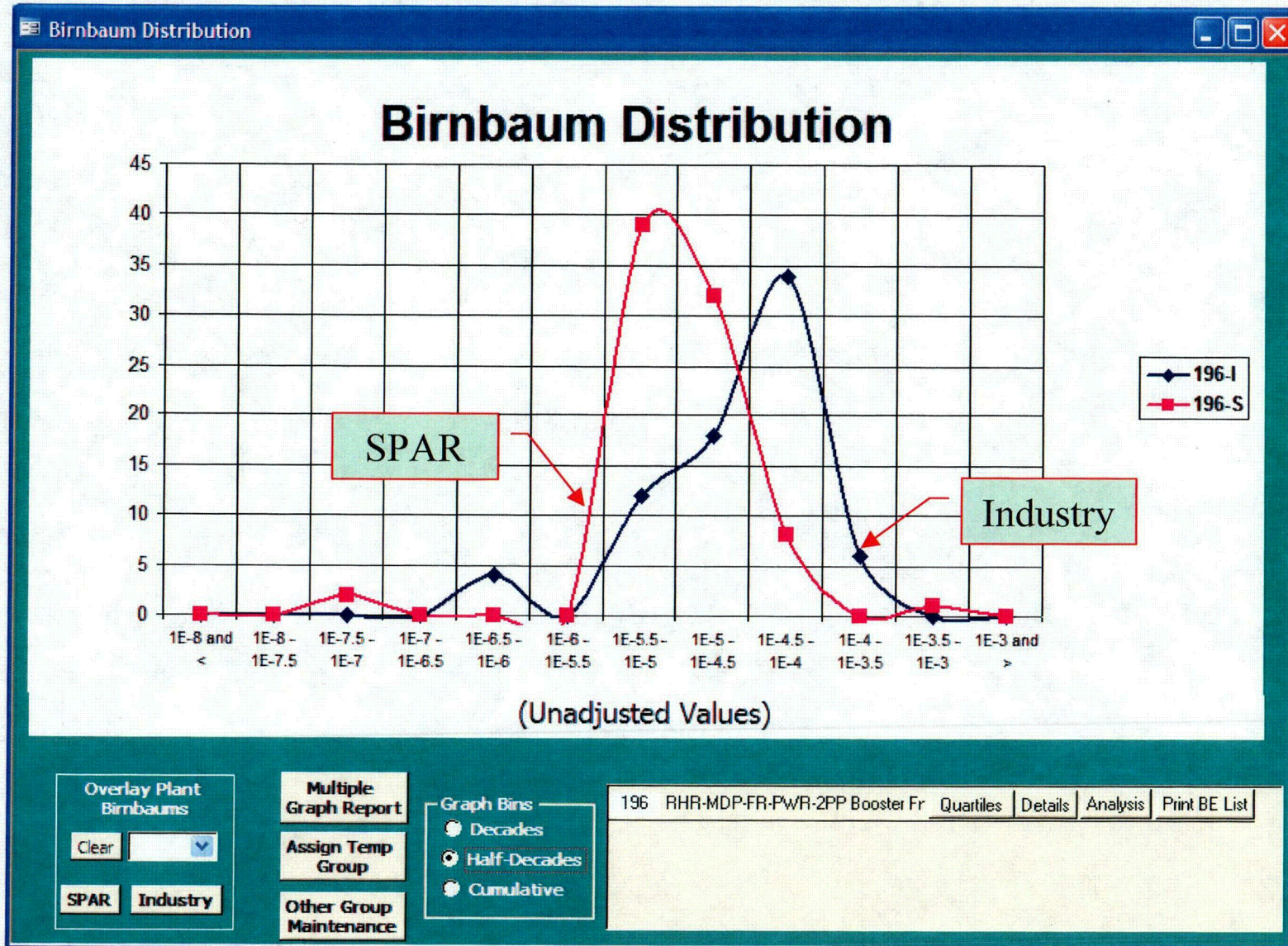
AFW- TDPs – Plants with One TDP



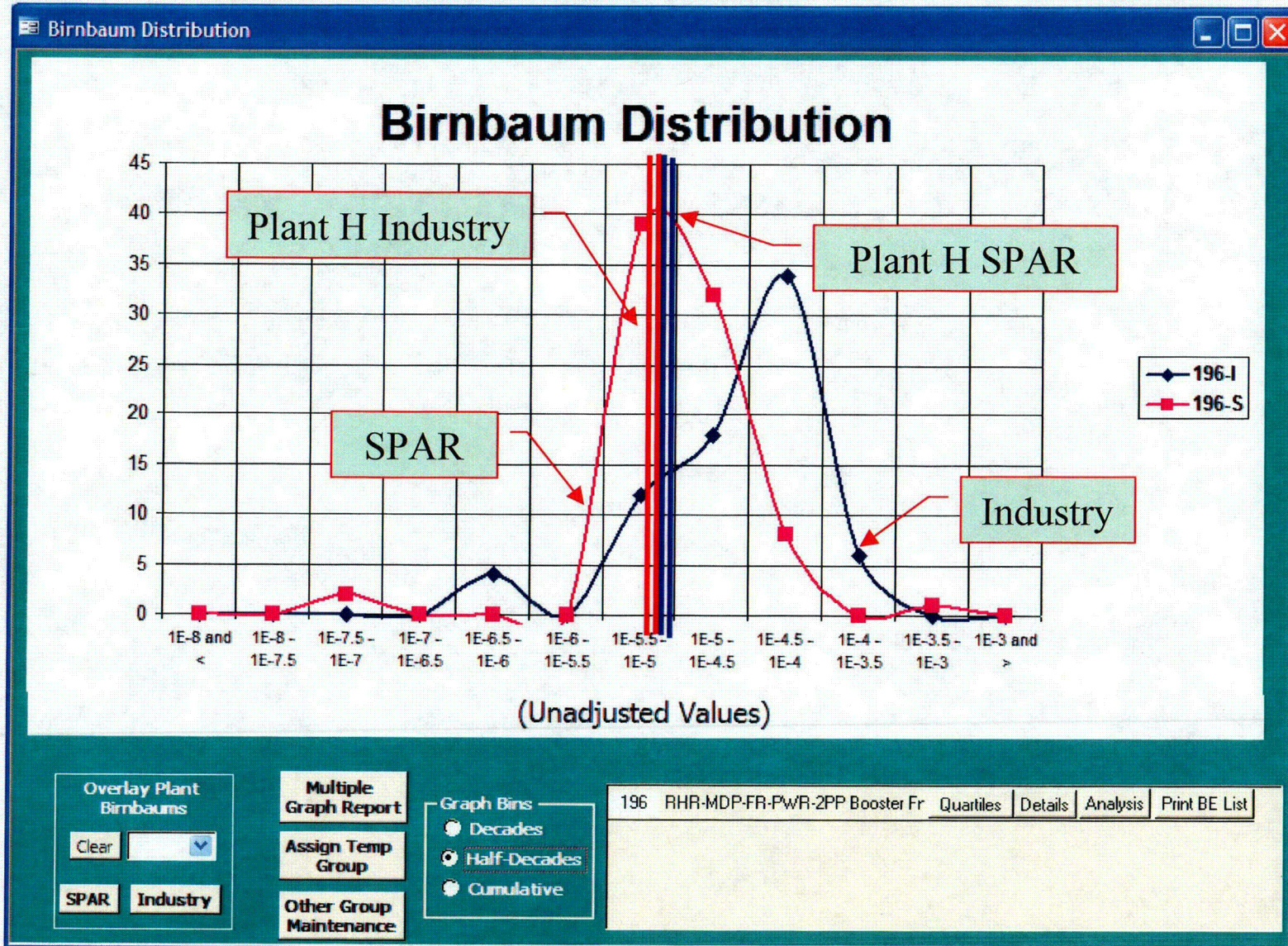
AFW- TDPs – Plants with One TDP



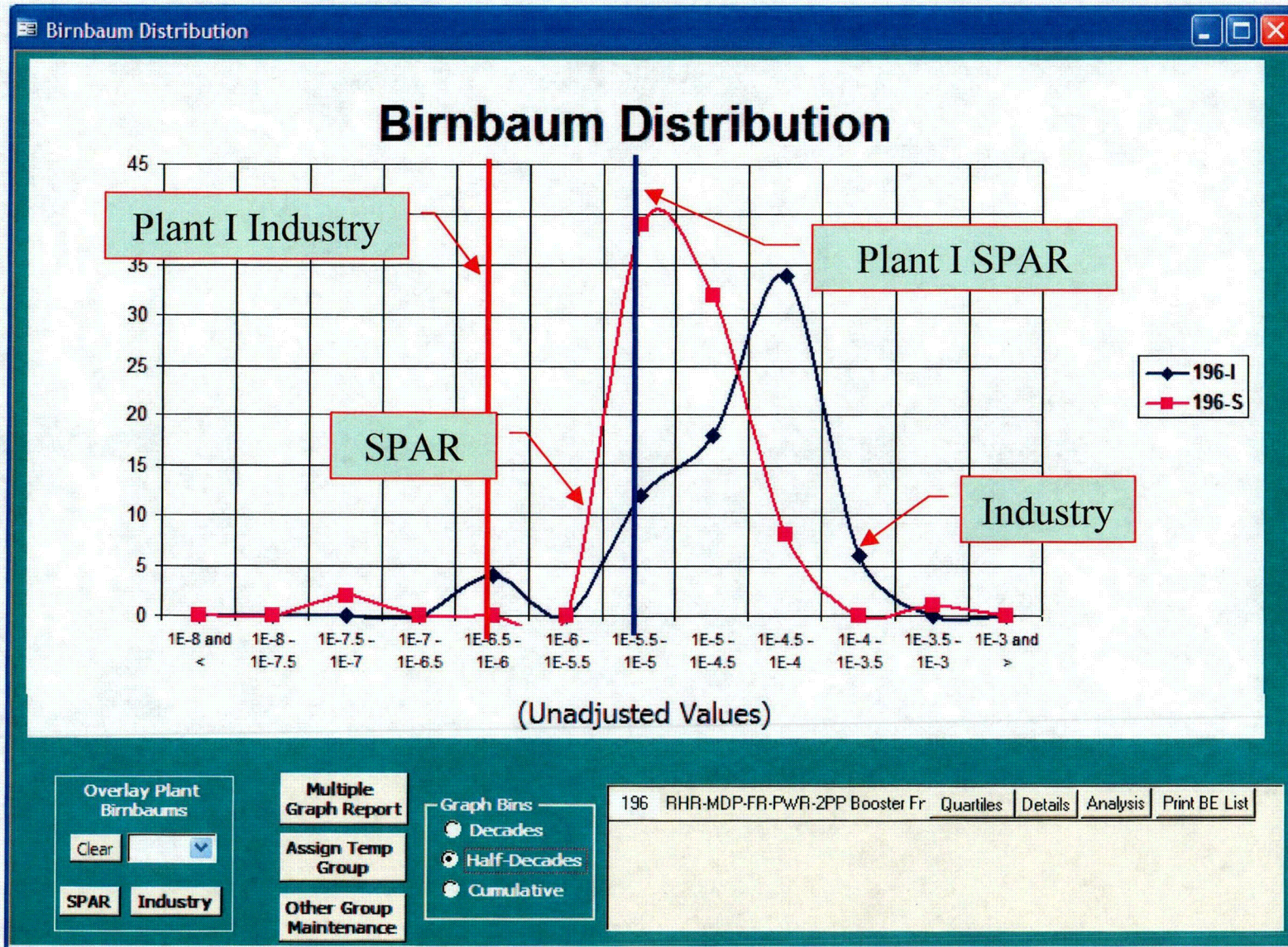
RHR MDPs – PWR 2 PP Systems w/ HPR Booster Function



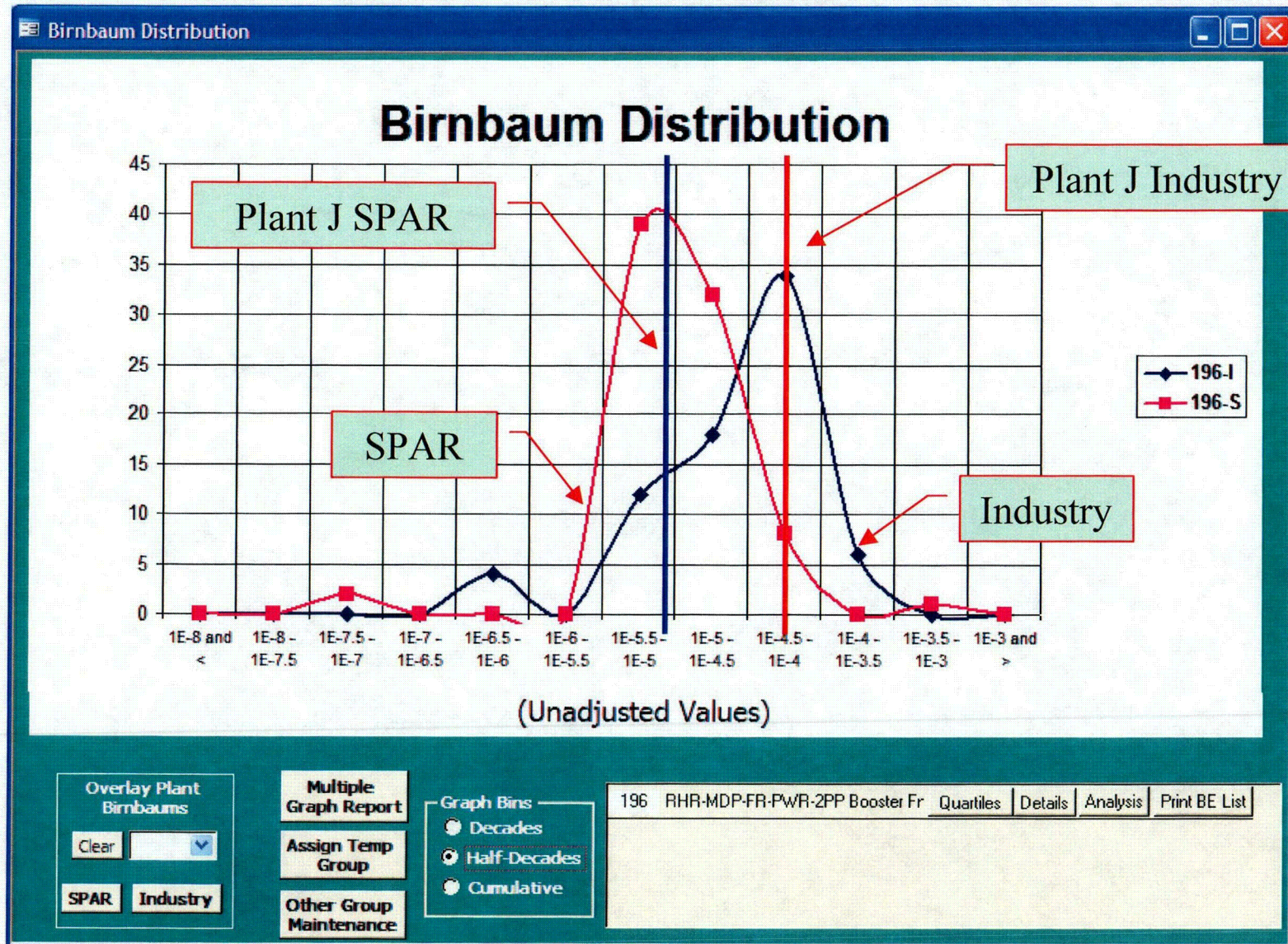
RHR MDPs – PWR 2 PP Systems w/ HPR Booster Function



RHR MDPs – PWR 2 PP Systems w/ HPR Booster Function



RHR MDPs – PWR 2 PP Systems w/ HPR Booster Function



Summary

- **Preliminary Industry data for most major components have been uploaded into database**
- **Groupings for PWRs well-defined**
- **Good overlap of Industry and SPAR Birnbaum distributions for most system components**
- **Plan to use rank-ordering of Birnbaum differences by quartile to prioritize “candidate outliers”**