From Independent Power Producers to Performance Management Contracts, Guam Power Authority's Long Road Towards Reliable Power

John J. Cruz, Jr., P.E.
Manager, Strategic Planning & Operations Research
Guam Power Authority

Frank S. Blaz
Manager of Generation
Guam Power Authority

Jennifer G. Sablan
Assistant Manager, Generation (Acting)/Special Projects Engineer - Mechanical
Strategic Planning & Operations Research Division
Guam Power Authority

Arlene M. Aromin, P.E.
Special Projects Engineer - Electrical
GPA Executive Office
Guam Power Authority

1 Introduction

Guam Power Authority (GPA) is a not-for-profit municipal utility serving the Island of Guam. Currently, GPA serves approximately 45,752 metered customers. The Authority has an installed capacity of 552.4 MW total with a system peak of 281.5 MW.

GPA has pioneered public-private partnerships on Guam. GPA, Performance Management Contractors (PMCs) and Independent Power Producers (IPPs) maintain all of the Authority's base load power plants and a 40 MW reserve unit. GPA has energy conversion agreements wherein, GPA supplies fuel and purchase power from independent power producers (IPP). These IPPs include:

- Marianas Energy Corporation (MEC) – 88 MW slow speed diesel plant in Piti
- Taiwan Electrical & Mechanical Engineering Services (TEMES) – 40 MW combustion turbine plant in Piti, reserve unit
- Pruvient Energy – 53 MW refurbishment of GPA's Tanguisson power plant.

These energy conversion agreements run for twenty years after which GPA receives ownership of the plants.

Furthermore, the Authority has installed Performance Management Contractors for its baseload units at Cabras:

- Doosan Engine (Korea) operates and manages two 40 MW Man-BMW slow speed diesels plant (Cabras 3&4)
- TEMES manages and operates the two (2) 66 megawatt steam turbine generator units (Cabras 1&2).

This paper briefly describes GPA's journey in entering into these public-partnership contracts to provide reliable and efficient power to its customers.

2 History

At one point, GPA operated the Cabras 1&2 Steam Power Plant at over 98% availability. These plants were GPA's flagship units managed and operated by a power plant work force comprised of graduates of the U.S. Navy Apprenticeship Program and other seasoned journeyman with decades of experience took the Authority ably through the seventies and eighties.

However, in the late 1980's, the island economy began to move into overdrive. Increases in tourism as well as increased energy-use by residential customers fueled significant power requirement and energy sales growth for the Authority. In order to meet the increasing growth and energy demand, the Authority began the process of planning for new generation facilities in 1985. This resulted in the filing of a generation expansion plan in 1988. The plan culminated in the commissioning of Dededo CT 1&2 in 1992 and 1994 respectively.

While GPA and its regulators debated about the details of reserve requirements and load forecasts, GPA fell far behind the Load Curve. The magnitude and duration of load growth soon outstripped GPA's efforts. Figure 1 shows the historical growth in peak system demand from GPA's inception to present.

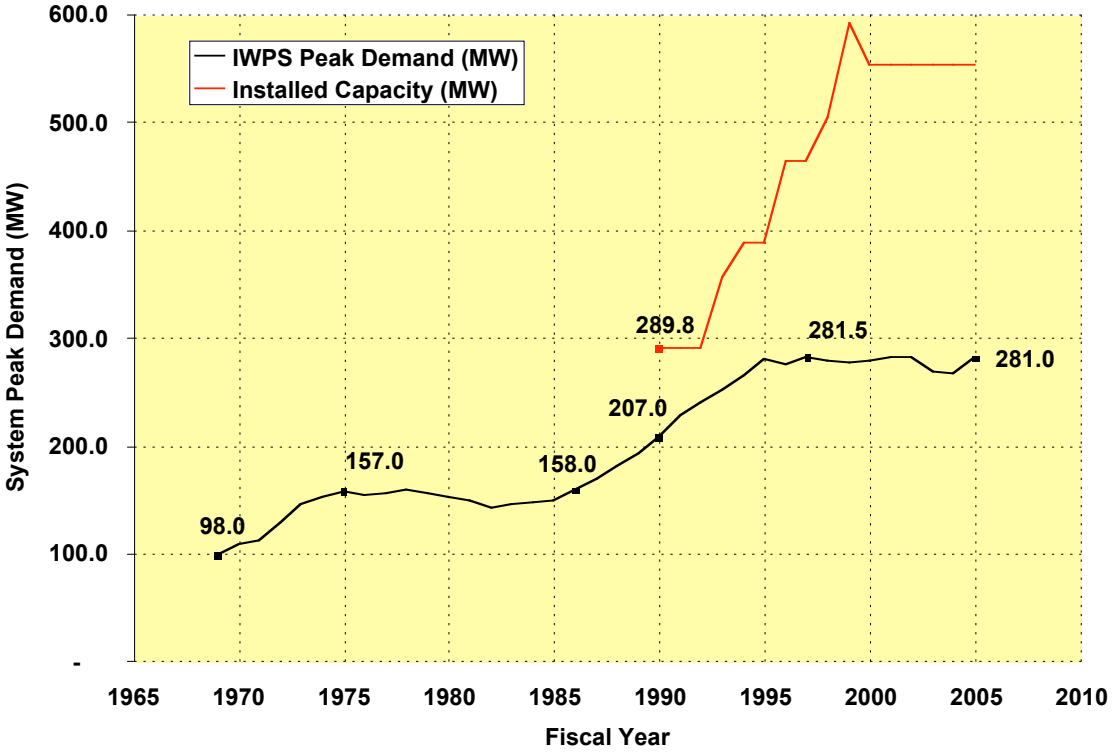

Figure 1 Guam Power Authority Historical System Peak Demand and Installed Capacity

In 1993, GPA commissioned 93.2 MW of "fast track" units. The first part of the 1990's is known as the "Load Shedding Blues" era. It was also during this time when many of GPA's experienced employees retired and like in many small island states, people of this caliber are difficult to recruit and retain. Deferred maintenance driven by external forces pushing to keep the lights on and in addition to a dwindling pool of experienced steam power plant personnel took a toll on GPA's baseload units. Table 1 shows Major Baseload Outages for the period FY90 to FY95.

Still in catch-up mode, GPA did not commission a new baseload unit until 1996 with the startup of the first of two 38.3 MW slow speed diesel units. In 1996, with its latest two units on the immature forced outage side of the life cycle forced outage rate curve ('bath tub" curve) and the remaining baseloads in disrepair, GPA with lawmakers intervention, went on Emergency Generation Procurement for Independent Power Producers (IPP) for an 80 MW slow speed diesel plant, a 40 MW combustion turbine reserve unit and rehabilitation and takeover of the Tanguisson Power Plant.

Table 1 Major Baseload Outages (FY1990 – FY 1995)

Generator Unit	Total Forced Outage Duration By Fiscal Year (hours)					
	90	91	92	93	94	95
Cabras Unit 1	2,101.50	58.70	614.10	110.35	128.54	1,445.80
Cabras Unit 2	38.50	3.50	58.70	462.35	279.27	913.29
Tanguisson Unit 1	55.20	67.50	66.60	150.38	359.70	5,011.85
Tanguisson Unit 2	127.90	66.60	871.60	472.37	734.87	3,959.67
Total	**2,323.10**	**196.30**	**1,611.00**	**1,195.45**	**1,502.38**	**11,330.61**

The energy conversion agreements (ECA) negotiated with each IPP have performance guarantees These performance guarantees include:

- GPA-MEC energy conversion agreements
  - Heat Rate
  - Availability (non-standard calculation)
- GPA-TEMES energy conversion agreements
  - Heat Rate
- GPA-Pruvient energy conversion agreements
  - Heat Rate
  - Availability
  - Equivalent Forced Outage Rate (EFOR).

The IPPs are responsible for operation, maintenance and capital improvement projects for their plants. In the case of Tanguisson, GPA personnel operate the plant under the management of Pruvient. Figures 2 – 7 show the historical performance of GPA's IPPs.

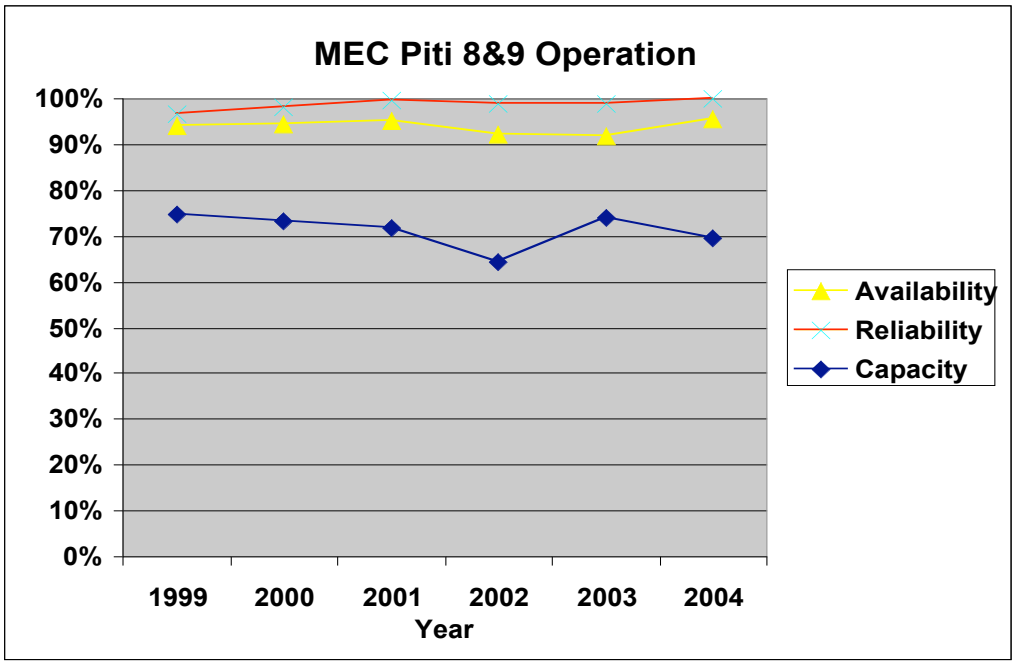

Figure 2

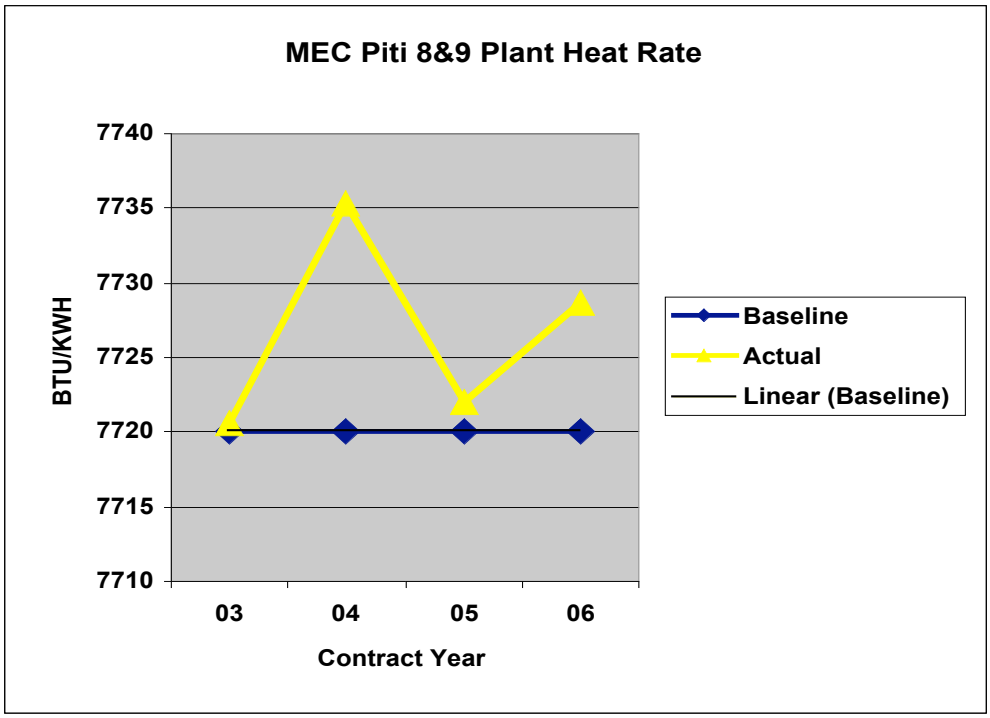

Figure 3

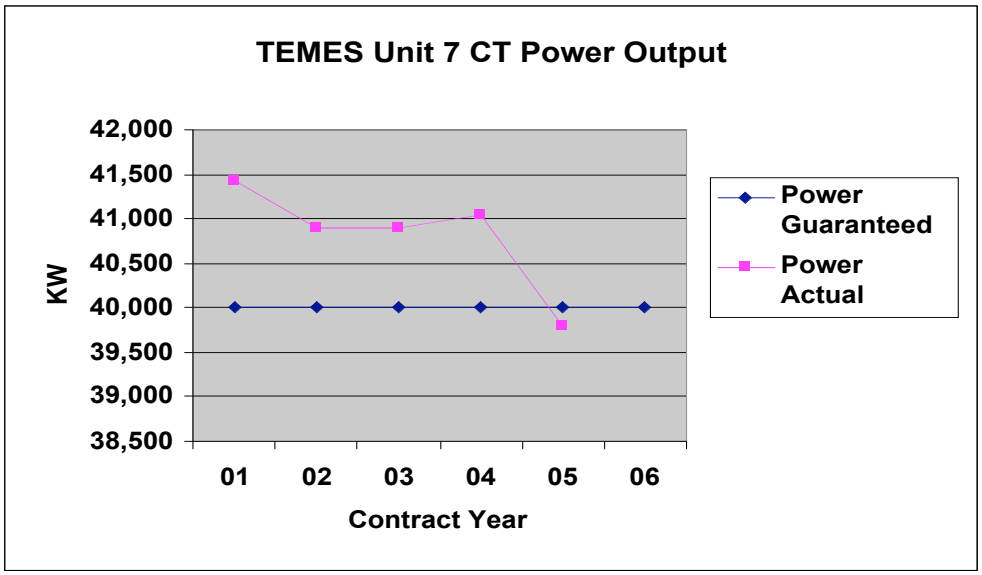

Figure 4

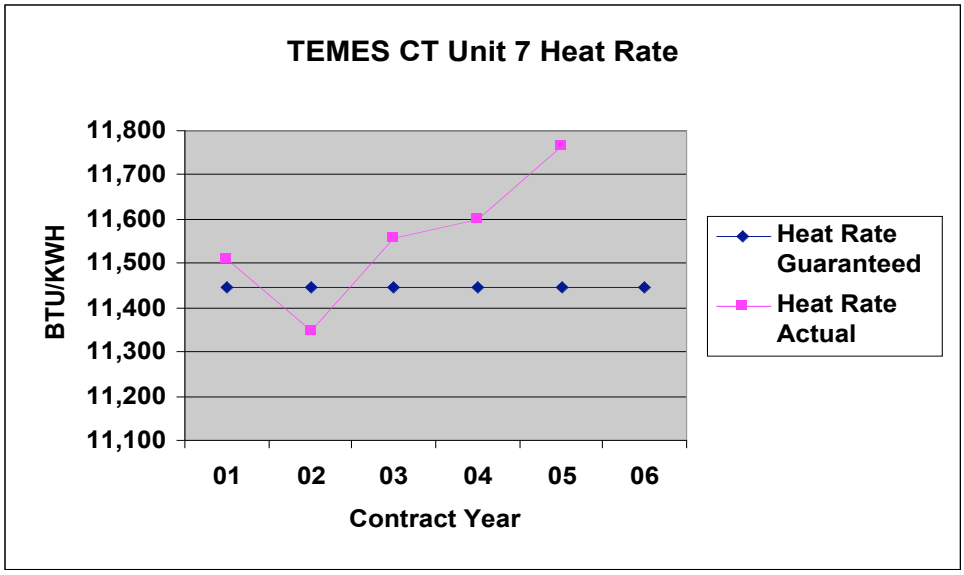

Figure 5

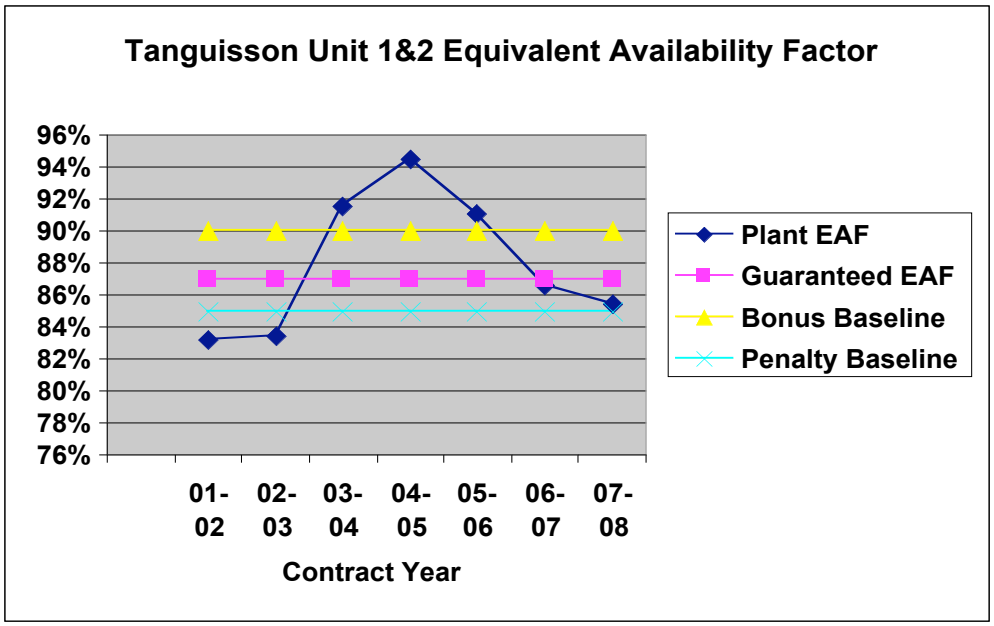

Figure 6

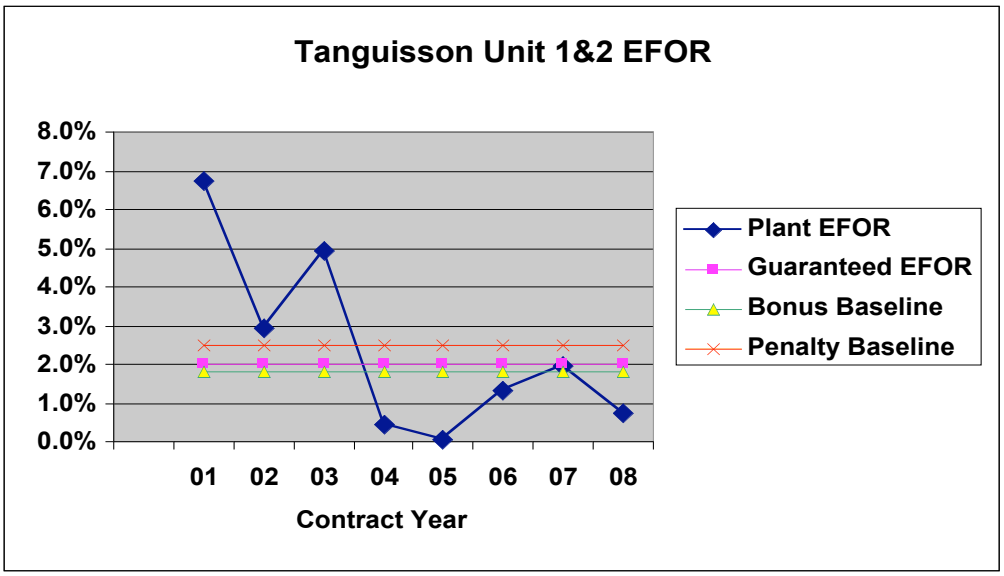

Figure 7

In 1996, GPA did not have the bonding capacity for additional generation while at the same time expanding and improving its transmission and distribution system infrastructure. GPA was in a position of strength and Independent Power Producers were the best political and financial option available.

The Independent Power Producers have for the most part, delivered on the promise of high reliability and efficiency as shown in Figures 2-7. However, for a well-run utility with access to the municipal triple exempt bond market, independent power producers are not the least cost option.

Studies conducted for GPA have concluded that refinancing the capital portion of these contracts at GPA's bond interest rates would lower GPA's costs by about five to seven million dollars annually. Additionally, some contractual and operational problems exist. GPA, IPPs and PMCs have worked collaboratively on a "System Stability Study" completed this year (FY 2005) to resolve these operational issues.

3 Performance Management Contracts: Conceptualization

From FY 1997 through FY2000, GPA's system planning group began to hothouse the performance management concept. It believed that GPA should right-source processes: GPA should continue to perform what is does well and outsource what it does not. In addition, the planning group moved the existing operations paradigms from optimizing for better heat rates and reliabilities to using minimization of system costs as the objective function. Under the initial paradigm, you optimize the plant. However, you might also increase total system operating costs to the point that these added efficiencies and reliability are not cost effective. Under the new paradigm, which opts for public power system operation, you invest capital when it becomes cost effective to do so.

There are several advantages to public power system operation:

- ***Public Power has no profit incentive:*** It is an obvious fact that private companies exist to make a profit. It drives them to compete and is at the root of their survival. However, a well-run public utility will produce power at lower cost than a similarly operated and sized for-profit utility.

- ***Access to lower interest triple exempt municipal bond financing:*** Since GPA's bonds are exempt from county, state and federal taxes; they are an attractive investment and can command higher yields with lower interest rates.

- ***Access to disaster recovery funding from the Federal Emergency Management Agency (FEMA):*** GPA is a government entity. Since transmission and distribution insurance is no longer available for damage caused by typhoons or other natural disasters, GPA relies on its own revenues and FEMA for disaster recovery expenses. These costs would have to be passed on to rate payers by private for-profit companies.

- ***Access to federal grant and loan programs:*** As a public entity, GPA is eligible for federal grant and loan programs that are not available for private for-profit entities.

- ***GPA is an economic catalyst for Guam:*** Vested interest in improving the local economy and work force.

There are several disadvantages as well:

- ***Arcane, restrictive procurement rules that are ill-suited for an industrial operations environment:*** GPA's Cabras Unit 1&2 Reliability Study[1] cites that adherence to government of Guam procurement laws has added significantly to the length of generation plant outages. This study was commissioned by the Generation Division at the same time as Engineering's study formalizing the Performance Management Contract concepts. This study was redirected and sublimated into the PMC effort.

- A limited pool of local expertise: GPA does not have access to experienced and very specialized engineering, technical and operations personnel. GPA would do well to contract a management team with a ready access to a deeply experienced and specialized work force.

- Guam had no local comprehensive power plant operations education and training program: During this period, GPA had not yet set up its U.S. Bureau of Labor certified apprenticeship program. The demise of the local U.S. Navy Apprenticeship program had greatly reduced GPA access to a pool of local, highly specialized skilled journeymen. During the military base closures and reductions in force of the nineties, many local journeymen left island for better pay or to complete their federal retirement requirements.

- Cash flow availability limitations: The PMC study indicated that contracting to qualified organization capable of providing financing for plant improvement and capital improvement projects would be beneficial in a GPA cash flow crunch.

4 Performance Management Contracts: A Reality

In the early FY 2000, GPA presented the PMC concept to the Guam Public Utilities Commission (PUC) and the PUC consultant, Georgetown Consulting Group. The Guam Public Utilities Commission came up with the idea of creating a lock box account for GPA for the sole purpose of operations, maintenance and capital improvement projects. However, the PUC abandoned this lock box concept after being presented with the PMC concept. The PUC in subsequent dockets declared that the PMC concept is the implementation best suited and least cost for resolving GPA's generation reliability problems. The PUC directed GPA to begin the RFP process for all baseload plants then under GPA management and operation.

GPA engaged the services of New Energy Associates of Atlanta, Georgia and their subcontractor Information-2-Energy to assist in the drafting of the Request For Proposal (RFP) documents for a Performance Management Contract for Cabras 1&2. In addition, GPA and the PUC worked collaboratively in the drafting of this RFP. In preparing the

[1] GPA contracted the *Cabras Unit 1&2 Reliability Study* out to Information-2-Energy.

RFP, GPA further refined the PMC concept. The following summarizes the breadth of GPA's Performance Management Contracts:

- Financing: Contract specifies that GPA has the primary funding responsibility for Capital and O&M Improvement Projects and compensate the PMC on a reimbursable structure. However, GPA may request PMC to consider optional participation in placing short term capital funding. Financial integrity was a requirement in the selection for the successful Bidder.

- Budgeting: The O&M Spending limit has been established in the Contract. Incentives and penalties are imposed should the PMC exceed beyond the budget. This structure allows for GPA to have a firm projected O&M Spending budget each fiscal year.

- Compensation Structure:

    1. Fixed Management Fees: Annual management fees specified in the Contract.
    2. O&M Spending Payment: The PMC is reimbursed on actual cost not to exceed the maximum spending lime for each contract year.
    3. Performance Improvement Projects / Capital Improvement Projects Payment
    4. Dynamic Incentive and Penalty Payments: The PMC is awarded incentive payments for measured performance in excess of guaranteed performance improvements. The PMC is also penalized for under achievement of guaranteed performance levels.

- Staffing:
    - PMC Management Responsibility: The PMC manages and directs the GPA Classified Work Force. They participate in employees performance reviews, transfers and reassignments.
    - GPA Management Responsibility: GPA administers salary, benefits, grievance and disciplinary actions of the classified employees and manages hiring and personnel turnover issues with input from PMC.

- Training: The PMC is required to provide the following training programs for GPA Employees:
    - Operational Line of Progression
    - Maintenance Apprenticeship Style Training
    - Leadership Skills
    - Five-year personnel development plan
    - Apprenticeship Program Cooperation

- Operations:
    - Improve existing operational procedures
    - Create additional operation procedures

- Environmental compliance

- Maintenance:
  - Create outage planning process procedures
  - Optimize outage scheduling & planning
  - Create a Quality Improvement & Root Cause Analysis culture
  - Manage maintenance functions using the computerized maintenance management system
  - Maintain spare parts inventory
  - Optimize store inventory

- Performance Improvement Projects: The PMC is responsible for the recommendation, scheduling, implementation and management of all GPA approved projects.

- Outsourcing: In order to expedite outsourcing, the PMC has full procurement authority. Main goals are to recognize and address the critical path in outage planning, minimize unscheduled/forced outage time during critical system capacity shortages and expedite repairs of critical equipment. GPA has full auditable verification authority of all PMC expenditures.

- Communication and Reporting : The PMC is required to provide the following reports for GPA's review and approval:
  - Auditable reporting of performance measures
  - Track the project management of PIP's
  - Supporting documentation for grievance & disciplinary actions and employee recognition
  - Off-specification variance reporting
  - Incentive compensation calculations

5 Performance Management Contracts: The Experience

The incentive structure of GPA's Performance Management Contracts has significantly impacted the value of the PMC Contract. GPA contracted the PMC for performance guarantees on the following:

- Equivalent Availability
- Relative Heat Rate
- Staff Optimization
- Operations and Maintenance Spending
- Personnel Overtime Spending

The above performance guarantees are carefully tracked by GPA and the PMCs to derive to the incentive/penalty compensation calculations agreed by both parties each contract year. Figures 8 and 9 show Cabras 1&2 and Cabras 3&4 Power Plants Historical Vs. Post PMC Equivalent Availability Factor Performance. Figure 10 shows Cabras 1&2 Power Plant Historical Versus Post PMC Plant Relative Heat Rate Performance and

Figure 11 shows Cabras 1&2 Power Plant Historical Vs. Post PMC Plant Efficiency Performance.

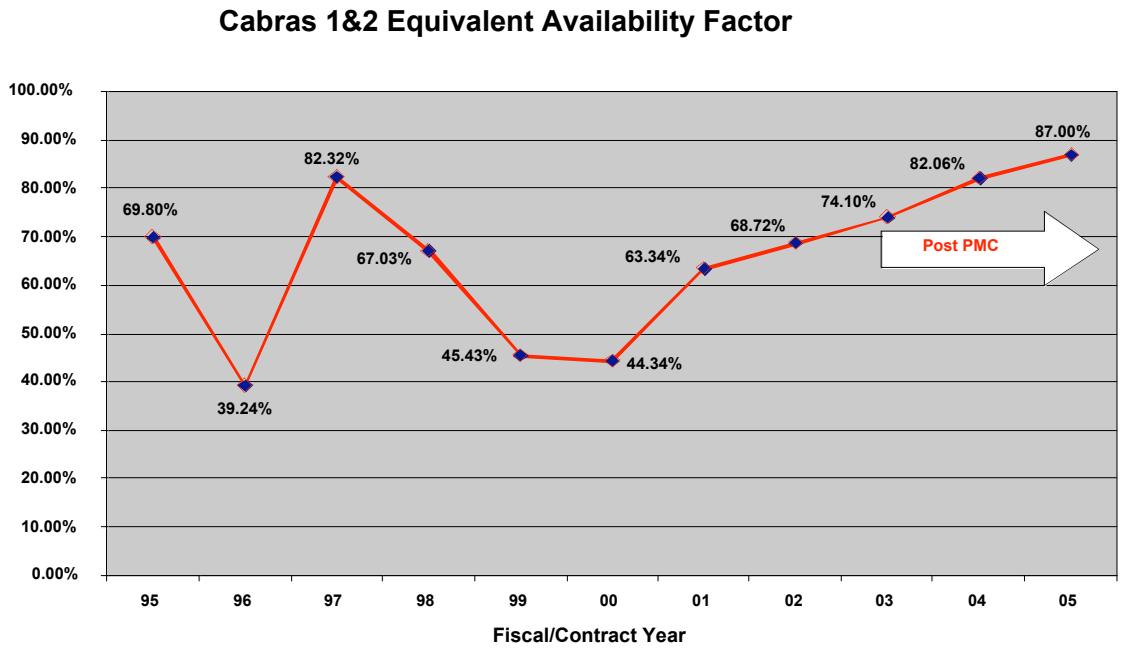

Figure 8 Cabras 1&2 Power Plant: Historical Vs. Post PMC EAF Performance

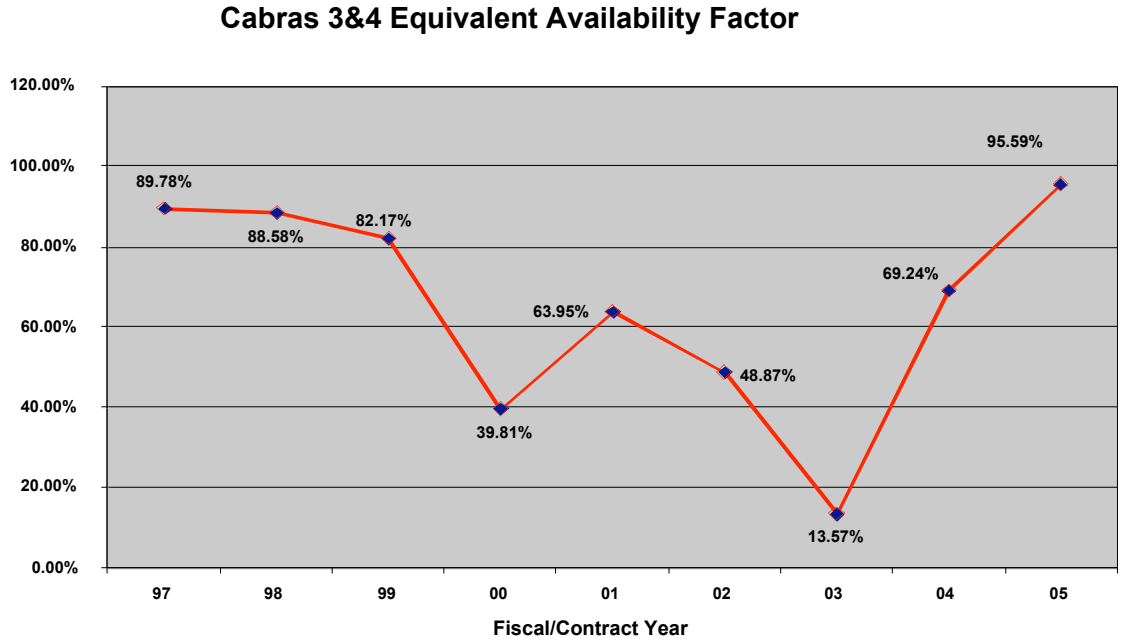

Figure 9 Cabras 3&4 Power Plant: Historical Vs. Post PMC EAF Performance

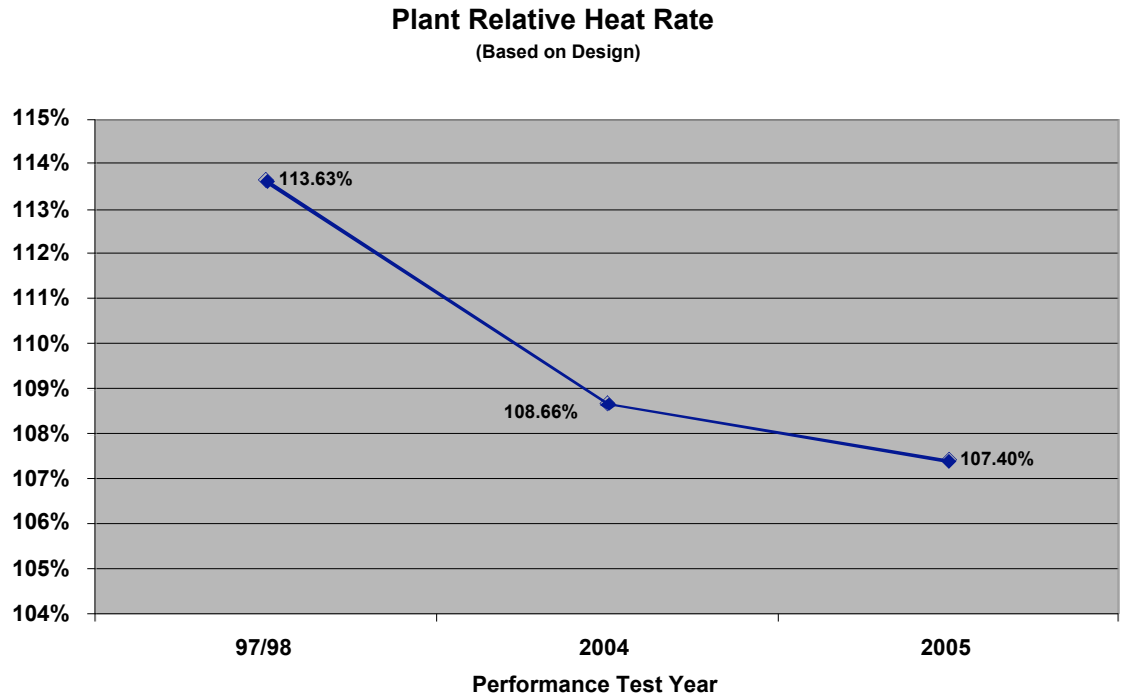

Figure 10 Cabras 1&2 Power Plant: Historical Vs. Post PMC Plant Relative Heat Rate Performance

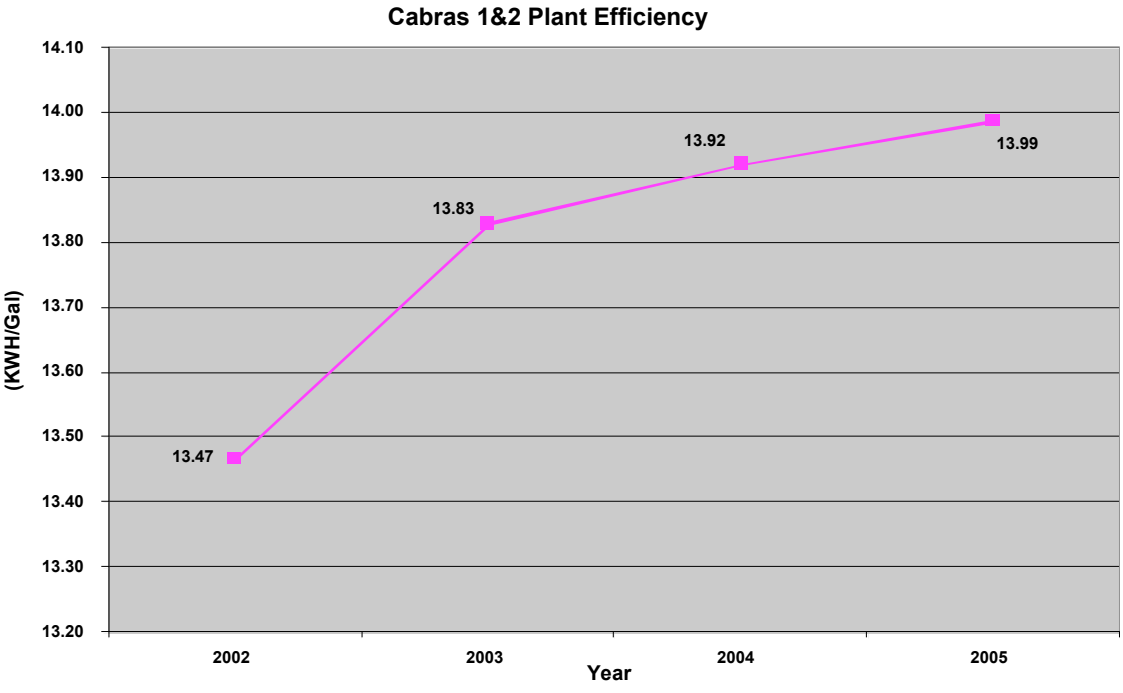

Figure 11 Cabras 1&2 Power Plant: Historical Vs. Post PMC Plant Efficiency Performance

As shown in these graphs, significant improvements in plant availability as well as efficiency immediately resulted after PMC management of both plants. This improvement is mainly due to better outage planning and expedited outsourcing allowed within the PMC contracts. Table 2-4 below show the completed Performance Improvement Projects by GPA, TEMES PMC and Doosan PMC.

Project	Cabras Unit
CWP Piping Replacement***	1&2
Reheater Replacement	2
Condenser Cleaning/NDE/Tube Repairs Sleeving	1
Boiler Drum Levels	1&2
Cables at Boiler Front	1&2
Turbine Lube Oil Purifier	1&2
FWH Level Adjustment	1&2
Cable Trays in Basement	1&2
Safety Valves Refurbishment	1&2
Turbine Roof Exhaust Fans Replacement	1&2
Boiler Performance Test	1&2
Boiler Condition Assessment	1
Scaffolding	2
Vestibule Repairs	1&2
Stack Repair	1
Boiler Feed Pump Motor	1
Service Air Compressor	1&2
Main Transformer Oil Replacement	1
Turbine Minor Inspection	1
Turbine Balancing Unit 1	1
Turbine Balancing Unit 2	2
Instrument Specialists	1&2
Major Steam Pipe NDT Preparation	1
Unit 1 Air Preheater Basket Repair	1
Unit 2 Air Preheater Basket Repair	2
Typhoon Damaged Repairs	1&2

Table 2 - Contract Year 1 Completed Capital and Performance Improvement Projects Cabras 1&2

Project	Cabras Unit
Start-Up Transformer and Duct Line Replacement	1&2
Turbine/Generator Overhaul - Unit 1	1
Turbine/Generator Overhaul - Unit 2	2
Reheater Replacement Project	2
Safety Valves Installation	2
Turbine Expansion Joint - Material & Specialist	1&2
Air Preheater Basket Replacement	2
Flue Duct Expansion Joint	2
Spring Hangers & Rod	1&2
Boiler Drum Level Installation	1&2
Fuel Oil System Renovation	1&2
Control Valve Refurbishment	1&2
Arch Tube Replacement	1
MS Piping Hanger & Deaerator Replacement***	1&2
#5 HP Heater Tube Replacement	2
Boiler Condition Assessment	2
Deaerator & Storage Tank	1&2
Sootblower Repair	1&2
FDF Rotor Replacement	1&2
CWP System Renovation	1&2
Condenser Tube Detection System	1&2
Air Preheater Basket Replacement	1
Boiler Chemical Cleaning	1
Boiler Chemical Cleaning	2
Fire Fighting Design/Assessment	1&2
Water Treatment Facility***	1&2
MS Piping & Deaerator Asbestos Abatement	1&2

Table 3 - Contract Year 2 Completed Capital and Performance Improvement Projects
Cabras 1&2

Project	Unit
Scavenge Air/Drain Mist Catcher Modification	3
Replacement of Fuel Oil and Fuel Oil Return Lines	3&4
Replace Control Panels (Travelling Screen Area)	3&4
Piston Cleaning Ring Modification	3&4
Protective Structure for F.O. Day Tank Heaters	3&4
40' Storage Container	3&4
Exhaust Gas Receiver Modification	3&4
Elevator Repair	4
Turning Gear Housing	4
Turbo Charger Silencer Upgrade	3
Modification of Expansion Joint For Exhaust Valve Cooling Water Outlet	3&4

Table 4 - 2005 Completed Capital and Performance Improvement Projects
Cabras 3&4

The salient result of Performance Management Contract implementation is savings for GPA and its ratepayers. Figures 12 through 16 illustrate the IPP and PMC contract fees, performance status and savings. Guam's journey towards reliable power has come a

long way. By thinking out of the box, right-sourcing and right-sizing, Guam Power is delivering sustainable reliable power to its rate payers.

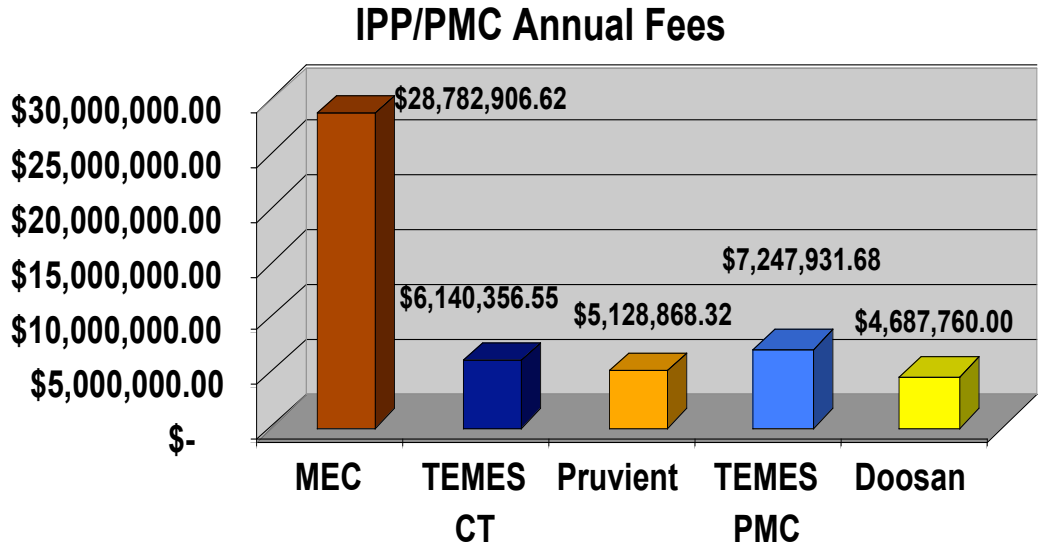

Figure 12 Contract Fees

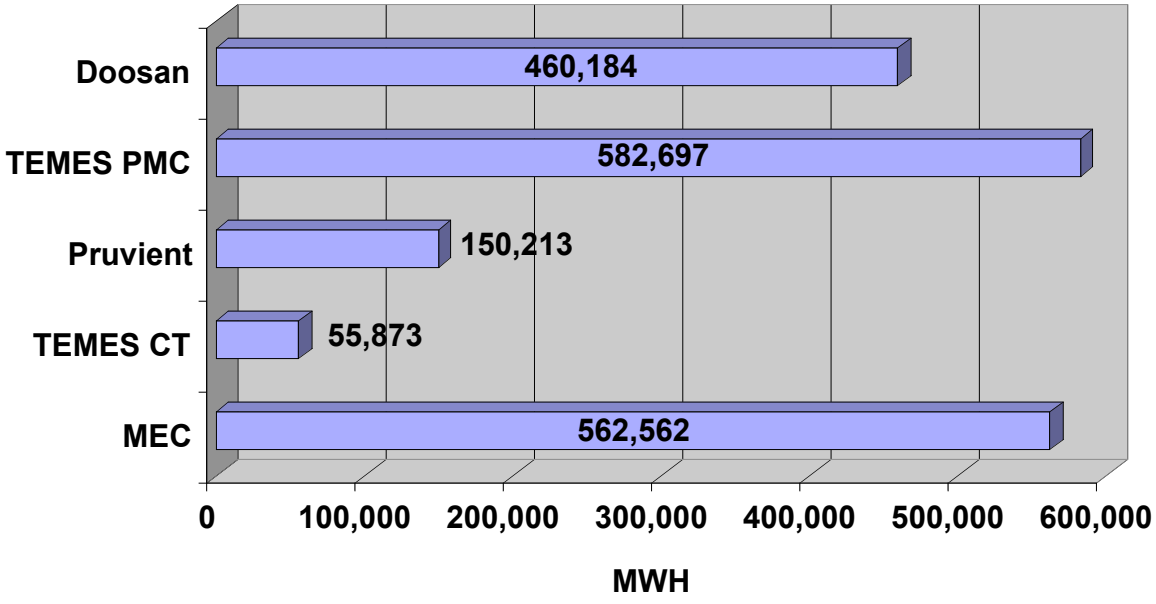

Figure 13 Net Generation

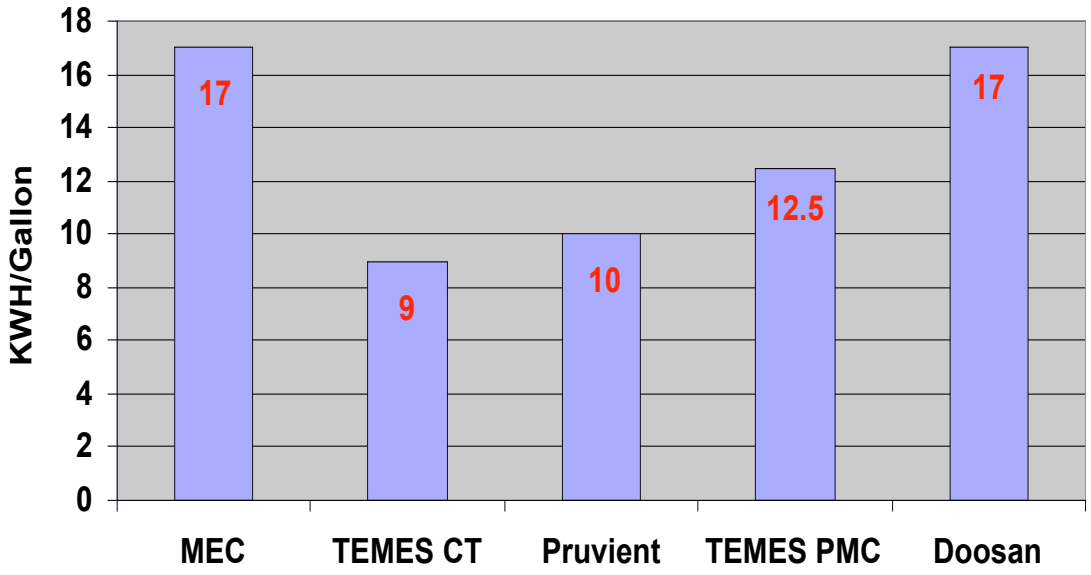

Figure 14 Plant Efficiency

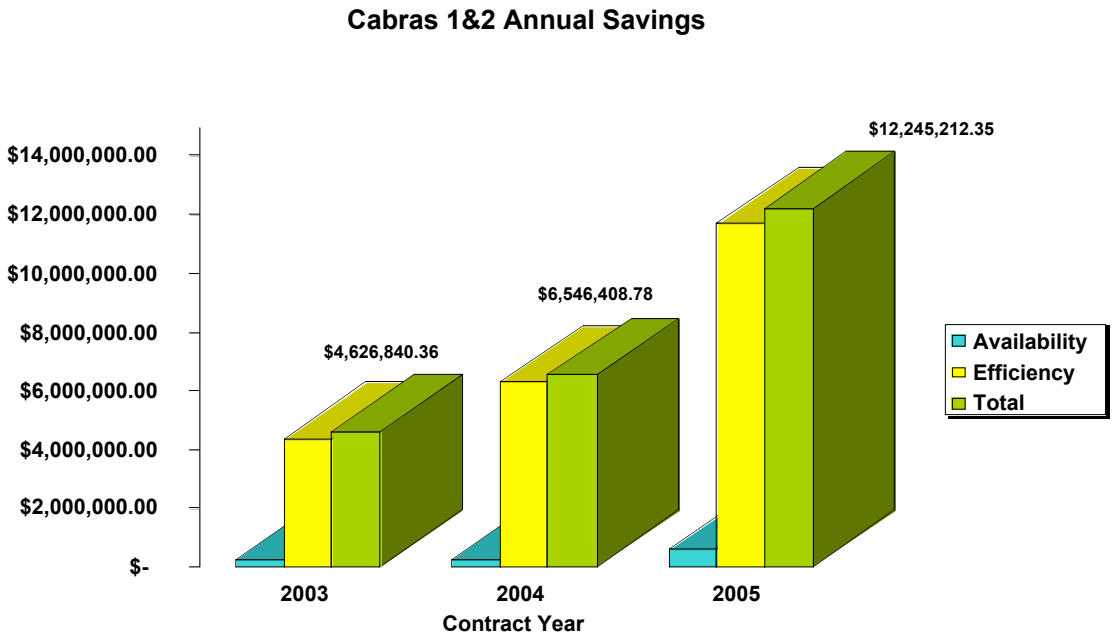

Figure 15 Cabras 1&2 Power Plant: Historical Vs. Post PMC Plant Annual Savings

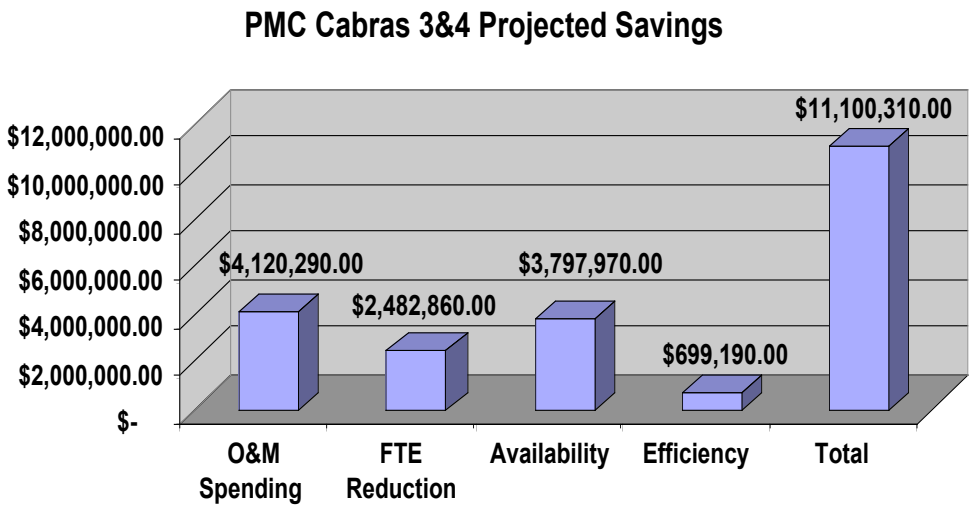

Figure 16 Cabras 3&4 Power Plant: Projected Annual Savings