Customized Operation and Maintenance
For Fossil Power Plants

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1. Introduction

The primary objective of every power plant owner is to get constructed and to operate his plant as cost-effectively as possible to maximize his profit. This means that he has to minimize – besides the investment costs for construction - the life cycle costs, which are influenced by different factors. One of them is the operation and maintenance cost incurred in course of operation period of the power plant.

The power plant utilities are further driven to reduce their life cycle costs by the deregulation of the different power markets.

Cost reduction by outsourcing of O&M activities is one opportunity to meet such requirements.

This presentation shall give an overview of the O&M Services shown on the example of the Arrúbal project in Spain as well as the approach to customize services in compliance with different clients and market requirements.

In general our service experiences are based on operation and maintenance of combined and open cycle power plants being equipped with gas turbines and other OEM components. A track record of the performances of the power plants under an O&M contract is shown exemplary for the power plants Paka (800 MW) and Pasir Gudang (400 MW). Both plants are located in Malaysia and are owned by the Malaysian construction company YTL Corporation. The track record has been published by the operations company YTL Power Services, a joint venture of Siemens AG (51%) and YTL Corporation (49%). After the know how transfer to YTL Power Services was achieved the joint venture contract was terminated as planned in the year December 2001. Since, that date YTL Power Services is a 100% subsidiary of YTL Corporation.
2. Range of Service Products

A wide range of service products from the simple supply of spares to integrated asset management is offered.

Due to the recent market developments, the focus is now, more and more on Long Term Service products. The scope of such Long Term service products can vary according to customer demands. To optimize customer’s benefit and to minimize customer’s risk in the project several service products are available.

A service package of O&M products can be customized as to meet customers specific needs: comprehensive maintenance programs for Gas Turbine, Power Train or for the whole Plant can be provided.
3. **Competence Network**

It is of great importance to a power plant owner to be informed about the concept of how the fleet experience of an OEM/O&M contractor is introduced and available to his power plant. Since the experiences gathered by people is among others a significant source of know how, thus we deem it as essential to use OEM managers as O&M managers at the power plants. The use of OEM managers at the plants facilitates the exchange of information across the plants as well as across OEM works.

Due to the high availability demand and the life cycle cost reduction requirements of power plants a permanent improvement of the O&M services is requested. To fulfill these requirements a competence network has been established.

The Service Back Office located in Erlangen collects all O&M experience of the individual Power Plants. Depending on the results of this ongoing evaluation, new improvements and developments are being pursued.

The Service Back Offices evaluate and assess all the improvements and distribute this information to the individual Power Plants. In addition to these procedures annual global O&M manager meetings ensure direct exchange of experience.
3.1 Power Diagnostics™
An essential part of the competence network is Power Diagnostics™ which enables operators to minimize the life cycle costs of power plants and at the same time maximize the output of electrical energy. The drive to reduce life cycle costs results among other things in the reduction of staff and labor costs. Whereas the desire to maximize electrical output requires to raise the availability, reliability and efficiency of the plant. A solution for high availability, reliability and efficiency with minimum staff is Power Diagnostics™.

The Power Plants covered under a long term service contract can be connected via telephone line to the Power Diagnostic Centers in Erlangen or in Orlando. The Power Diagnostic Center has access to the data monitored continuously at the power plant for all important operation values such as temperature distribution at gas turbine outlet, vibrations, operation hours, gas turbine start-up curves, performance curves etc. Experienced plant managers monitor the data in the Power Diagnostics Center and analyze these values with the objective to:

- Determine the actual conditions of systems and installed components,
- Evaluate the power plant performance.
If needed the Power Diagnostics Center has direct access to specialised OEM know how, i.e. consultancy through specialists for Gas turbine, Generator or Steam turbine. In case of detected abnormal trends, events or trips, recommendations for predictive maintenance actions are given. The Power Diagnostics Center is one of the important features for early detection and prevention of damages.
Benefits of Online Plant Thermodynamics

- Identical thermodynamics code for plant design and online monitoring provides highest accuracy due to applied OEM knowledge

- Online Thermodynamics detects as well decreases in performance of plant components (failures, degradation) as also drifting measurements (which can have an impact on operation due to I&C settings)

- Advantages also for understaffed plants
  Remote performance evaluations are offered by Siemens PG Power Diagnostics™ Organization as a service, carried out by highly trained specialists.

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Analysis of unit data utilizing diagnostic tools can identify problems before they become critical
3.2 Reliability Centred Maintenance

A logic supplement to Power Diagnostics with its feature of predictive maintenance is the introduction of a Reliability Centred Maintenance (RCM) method. The RCM Method allows to reduce the number of maintenance tasks specified in the product manuals of the various component suppliers. The component oriented maintenance schedule of the OEM suppliers will be redefined by an expert team consisting of OEM experts, maintenance managers, technicians and others. The expert team will define maintenance schedule with focus on the functionality of systems in the context of the actual operating regime.

As published by YTL Power Services a significant reduction of maintenance tasks has been achieved through introduction of RCM.
4. Quality

A certified quality system, ISO 9001 or equivalent, is a measure of growing importance of protection of owner’s assets especially on deregulated markets where beside electrical power also power plants are a merchandise. The perception of potential buyers is expected to be influenced positively if all processes related to operation and maintenance are integrated in a certified quality system, which is audited by an independent third party. As integral scope of an O&M agreement it is possible to develop and implement a quality system including a third party certification.

Quality means “First Class Plant Operation”
The Prerequisite: ISO 9001 Certification

First Class Power Operation by ISO 9001:

- Comparison with global competitors
- Transparent processes give common goals and motivation to the staff
- Living these processes means maximum control of the technical and financial aspects of plant operation

- Maximum Plant Availability
- Maximum Plant Profitability
- Positive Public Perception
- Maximum Staff Motivation

The benefit of a quality system can be maximized through combination with a computerized plant management system.
4.1 Computerized Plant Management System

The increasing competition in power markets is making cost-optimized power plant management indispensable. A significant cost factor is labor cost for plant staff. It is considered that 20% till 40% of the working hours are spent for finding, compiling and archiving information, e.g.

- Recording and maintenance of plant documentation,
- Provision of information on present plant’s conditions,
- Monitoring of defects, failures and their follow up,
- Prepare, issue and expedite orders for spare parts, material and services,
- Cost control for spare parts, material and services
- Process Permit to Work system,
- Control and follow up of deenergizing processes of related systems,
- Scheduling and Follow Up of plant outages
- Management of spare parts inventory.

The preferred solution is an intelligent, plant-wide IT support in the form of a plant management system – in particular for maintenance work, modifications, documentation and spare parts management. The experiences of our O&M projects show that the workload for information management can be limited to about 10% of the daily working hours, with the help of our IT solution for computerized plant management, BFS++™ System.
The functions offered by BFS++-System are in line with standard power plant practice (i.e. extensive adaptation is not necessary), and special needs can be readily integrated as required. The system is delivered in a reconfigured form with power-plant specific catalogues which consider the fleet experiences also derived from utilizing the fleet data storage collected through applied BFS++ systems. All this ensures fast, smooth integration and high acceptance.

BFS++ utilizes the hardware and software environment already in place in the power plant and also features field-proven interfaces to other systems such as DCS and I&C, Spares...
Ordering System and electronic documentation. This minimizes client’s initial investments and, ensures consistent, efficient processes. It offers it’s users a 3 in 1 solution covering operation, maintenance and administration processes from fault detection, through permit to work establishment up to spares cost control and inventory management.

A parameter to measure the stability of processes at a power plant is the downtime for major overhauls. The recorded downtime published by YTL Power Services for six consecutive hot gas path inspections over a period of 18 month shows a steady trend of continuous outage shortening.
5. O&M Contracts
Our substantial experience in the field of power plants including our commissioning experience is more than 500,000 MW installed capacity world wide. Our experience as operator is represented through more than 33 contracts with more than 12,000 MW. Beside this experience our Service organization has more than 90 Long Term Maintenance contracts with more than 35,000 MW. Through all this several worldwide experience our service organization has put in place a knowledge network sharing all relevant technical information through a home based back office.

6. O&M at Work
As part of our global experience record of projects we awarded 3 major projects in the last 2 years. These 3 projects are just an example out of the record.

6.1 Arrúbal:
Arrúbal is Siemens first major O&M’s award in Europe. Signature of this contract was completed in a fast track negotiation and will cover the full scope O&M for the whole plant for a period of approximately 12 years. In the following the project will be presented in more detail.
6.2 Tahaddart:

The moroccan Tahaddart customer (Energy Electrique de Tahaddart) EET is a shareholder company founded by ONE (Office National d'Electricite), ENDESA and Siemens as investors. Siemens O&M will operate the full plant and maintain all equipment delivered under the EPC contract. Tahaddart is a typical O&M project where all O&M activities are included for 20 years from commercial operation date in a firm level payment structure.
6.3 Kuo Kuang:

This 450 MW, 2 on 1 Combined Cycle Power Plant is an EPC Contract with Kuo Kuang Power Co.Ltd., a single purpose company. For his newly ordered Power Plant, the customer required an O&M contract in a new structure which considered that local supplies and services are partly directly handled by the owner, others are purchased and specified by O&M contractor in a guaranteed budget. The project is based on a customized contract structure tailored to owners needs. 14 years O&M including planned, unplanned and routine maintenance and operation of the plant.
7. Customer and Operator Synergies

The sum is more than just the addition! The know how of the Customer together with the O&M contractor’s experience ensure maximum long term asset protection.

An excellent example for synergies can be seen in the O&M procedures. What are the synergy contributions in this specific case?

The contribution of the customer is the know how in regard to regional power production requirements, and the long term experience in the local market as well as from the power plant ownership.

On the other hand, worldwide long term O&M experience is brought in by us.

These synergy contributions from both parties allow fastest possible elaboration of the O&M procedures and fastest possible installation of the ensuing engineering and administration processes.

7.1 Arrúbal Milestones of the Project

The Arrúbal O&M project schedule starting from submission of the proposal up to signing the contract was based on targeted negotiations in a very short time.

Handing over of the O&M proposal to Gas Natural: November 2001
Negotiation and Clarification: Summer & Autumn 2002
Signature of the O&M Contract: November 2002
Start Pre-Mobilization Phase: November 2002
Start Mobilization Phase: August 2003
Start Operation and Maintenance Phase: October 2004
7.2 Arrúbal Brief Description of the Scope

The Arrúbal O&M project is divided into 3 distinguished phases.

The first one is initial pre-mobilization phase in which EPC design will be reviewed for it’s maintainability. Within this period of time our implementation team puts also into place a spare parts purchasing specification and specifies the high availability spare parts package. This period starts at the beginning of the EPC implementation.

In the second phase - 12 months before the commercial operation of the plant - Start of assess and hire of local staff and training according to its specific needs. During that time the O&M staff will be also involved in the commissioning of the plant and set up all necessary administration and IT tools.

In the third phase, after the provisional acceptance of the plant, the O&M period starts and all routine, planned, unplanned and day to day operation will be handled by operator.
8. Benefits

Within the frame of O&M contracts, operator takes over significant share of customer’s risks. For example one typical warranty in O&M contracts taken by operator is an availability warranty.

An increased availability leads to increased revenues for the customer. Siemens has a proven record of increased availability beyond the typical industrial averages published in 2001 by EURELECTRIC, an independent non OEM organization. For Combined Cycle or Cogen Plants the median of:

- 267 unit years resulted in a unit capability of 85.7% (unit capability is equivalent to plant energy availability),
- 1966 unit years resulted in an accident rate per year and unit of 10.26 accidents.

**Highest Availability due to tailor-made Maintenance and Operation Contract**

Paka and Pasir Gudang

Industry Average Availability 86%

Statement from YTL Oct 2002, PowerGen Singapore

2 GT Major Overhauls

1 GT Major Overhaul
Minimum Number of Accidents due Health and Safety Competency

Statement from YTL
Oct 2002, PowerGen Singapore

May 6-8, 2003
Power Generation 40
Koln/Kaiserslautern
9. Summary

- Comprehensive operation and maintenance services are provided for entire power plants down to individual components.
- Services are based on worldwide operational experiences combined with detailed/country specific knowledge of power generating and distribution market.
- O&M services are supported by dedicated service back offices and Power Diagnostics Center. This center not only enhances the plant’s monitoring effectiveness but also provides fast experience information on generic problems, gained worldwide.
- Own maintenance management system called BFS++, provides comprehensive, cost saving services, contributing to plant’s availability and reliability increment.
- Presently trusted by clients worldwide to operate more than 12,000 MW and Long Term Programs for more than 35,000 MW.
- The recent three O&M contracts placed in Europe, Asia and Africa are proof of our competitiveness in this particular area,
- O&M services include also risks sharing with customers.