MANAGEMENT, OPERATION, AND MAINTENANCE SYSTEMS FOR WASTE FACILITIES

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ABSTRACT

This paper will discuss those capabilities which a qualified management, operations, and maintenance service contractor can bring to public or private waste conversion projects to assure their long-term technical and financial success. The discussion will focus on the management, operation, and maintenance systems necessary to support long-term facility operations, including management, staffing and training, quality assurance, budgeting/cost controls, and operations and maintenance management programs.

INTRODUCTION

Most public and private projects must stand on their own merits, and are often based upon local needs, alternatives, and/or economics. Figure 1 represents a list of the major project development considerations which must be addressed in developing a waste conversion project. The financial success of a project is a key element and hinges on a number of important factors. Therefore, with few exceptions, the financing of most projects is based upon:

(a) a long-term guaranteed or bonded fuel source (put or pay type contract)

(b) an established proven technology endorsed by a reputable engineering firm

(c) economics which are competitive to other long-term alternatives

(d) shared risks

(e) insurable risks

(f) ability to finance

(g) secured operational performance guarantees

Projects, both public and private, are typically developed by the owners through:

(a) full service contractors

(b) turnkey contractors

(c) A/E firms

A typical waste project system design would consider all factors related to acceptable operations and maintenance practices, as well as all applicable regulations, laws, and permit requirements. A model of the overall system design criteria for a solid waste facility is presented in Fig. 2. Regardless of the approach, the design, financing, and construction activities take 2 to 5 years to develop and implement, followed by 10 to 30 years of continuing operations.

The ability to finance a project, based upon an acceptable technology, is highly dependent upon the qualifications, risks, and guarantees to be provided by the operator. Numerous concepts exist for operating contracts, both in contract term and compensation incentives. Typical operating contracts must consider:

(a) engineering technology risks

(b) financial requirements

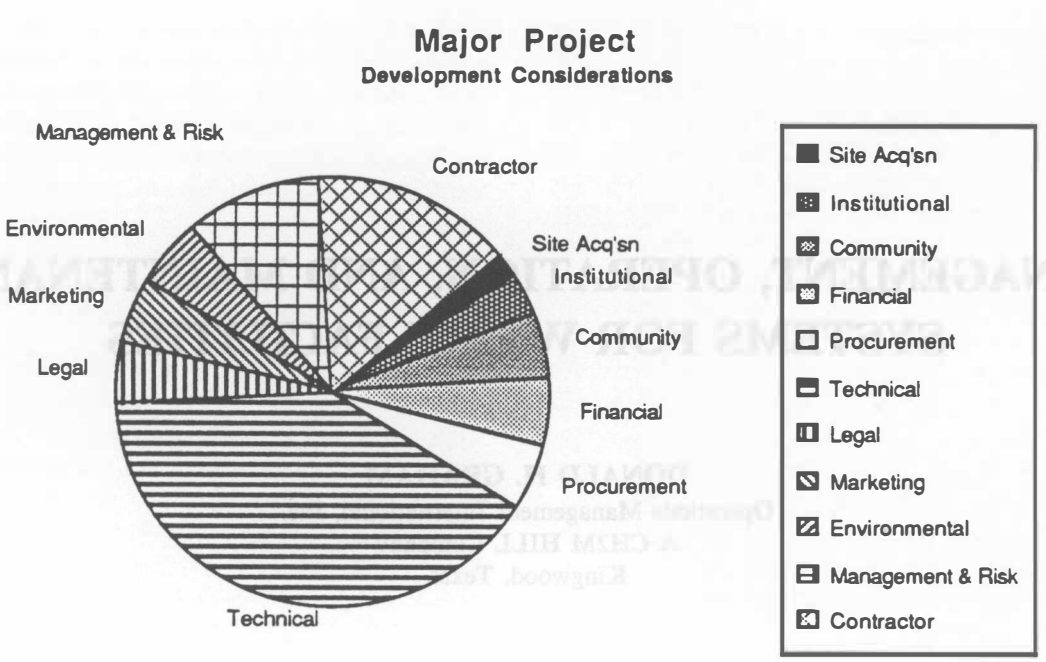

FIGURE 1

(c) uncontrollable circumstances

(d) contractual terms and reopeners for fee and risk reassessments

(e) turnkey construction contractor's acceptance obligation

(f) insurance risks and costs

Depending upon the project structure, the interaction and clear separation of these long-term risks is often a difficult contractual task, unless a full service contractor provides all services and guarantees, rather than subcontracting a portion, e.g., the long-term operations.

A major factor receiving considerable scrutiny, particularly when projects require long-range financing, is "Who will operate these highly sophisticated systems?" Investors sinking tremendous capital outlays into such a project must be assured that operations will not create greater risks than financial returns. Therefore, our presentation today focuses on those areas of concern beyond the above considerations, critical to selecting a service contractor to manage, operate, and maintain facilities after they are built. This industry's graveyard is full of projects which have failed simply due to poor management, operations, and maintenance. Incineration, energy production and resource recovery projects have become complex and highly regulated businesses. With technology still developing in the U.S., few firms have built operations and maintenance staffs capable of handling these complexities and associated risks. However, without a successful operations and management firm, the project is doomed to failure or, at best, facing financial chaos.

Significant issues which are of concern to management, operations, and maintenance subcontracting firm are:

(a) obligations, liabilities, securities, and term of service provided by the engineer and/or turnkey contractor, including, but not limited to, warranties, long-term latent defects, acceptance testing protocol and its duration

(b) waste supply, seasonal quantity variances, quality test protocol, and the interactions with project revenues and operator incentives

(c) risk allocation and sharing arrangements between all parties to the project

(d) clear cut provisions for establishing, defining, and managing the Nonroutine Equipment Maintenance Reserve Fund

(e) Force Majeure or uncontrollable circumstance provisions

(f) provisions to compensate for the costs incurred for failure of the facility to perform in accordance with original design specifications

(g) higher than anticipated operations and main-

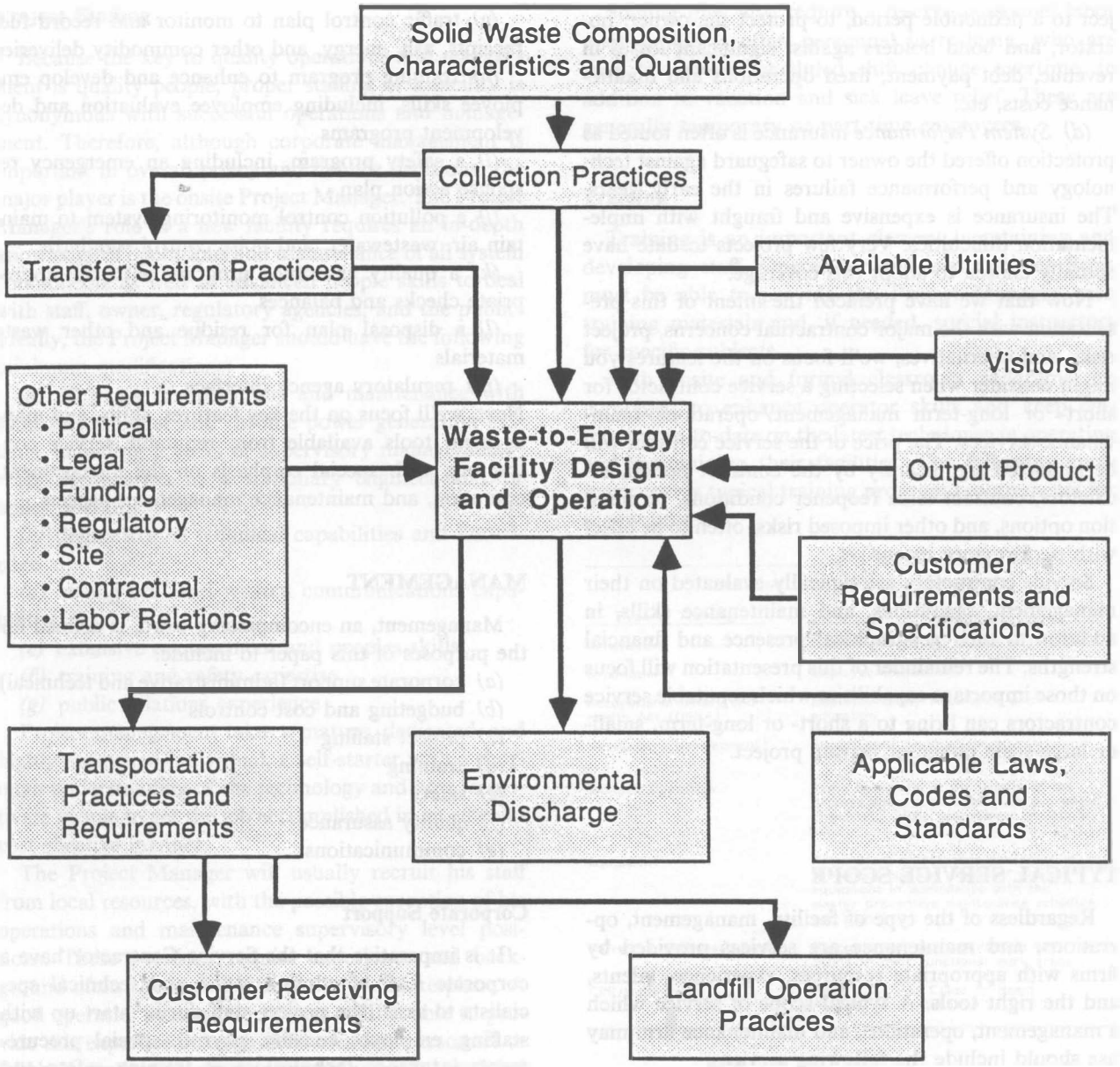

FIG. 2 OVERALL SYSTEM DESIGN

tenance costs due to maintenance, labor, service, taxes, insurance, et al., not attributable to operator's negligence

(h) committed residue disposal sites for life of project

Project risks can be assessed, identified, contractually shared, and in certain instances insured against. Operations risks which are often partially insurable are:

(a) Operating Contract Performance Bond protects owner or client against operator's contractual nonperformance or default. The policies are typically for the term of the agreement, in an amount equal to the annual contract fee.

(b) Boiler and Machinery insurance can be purchased to protect the owner/operator against catastrophic failures of the mechanical devices. These policies often have significant deductibles to exclude routine maintenance and repair claims.

(c) Business Interruption insurance is available, sub-

ject to a deductible period, to protect the owner, operator, and bond holders against significant losses in revenue, debt payment, fixed operations and maintenance costs, etc.

(d) System Performance insurance is often touted as protection offered the owner to safeguard against technology and performance failures in the early years. The insurance is expensive and fraught with implementation difficulties. Very few projects to date have actually chosen to adopt this coverage.

Now that we have prefaced the intent of this presentation with the major contractual concerns, project risks, and alternatives, we'll focus on the features you might consider when selecting a service contractor for short- or long-term management/operations/maintenance services. The price of the service contract will be impacted significantly by the contract period, escalators, contract term reopener conditions, termination options, and other imposed risks, often to be offset with performance incentives.

Service contractors are typically evaluated on their management, operations, and maintenance skills, in addition to their geographical presence and financial strengths. The remainder of this presentation will focus on those important capabilities which reputable service contractors can bring to a short- or long-term, small- or large-scale public or private project.

TYPICAL SERVICE SCOPE

Regardless of the type of facility, management, operations, and maintenance are services provided by firms with appropriate resources, experience, talents, and the right tools. A typical scope of service which a management, operations, and maintenance firm may use should include the following services:

(a) provision for all guaranteed costs for personnel, salaries, wages, and benefits to operate the facility properly 24 hr/day, or as required, including administration, supervision, and corporate support.

(b) procurement and payment of all costs including supplies, chemicals, utilities, and spare parts

(c) an operations plan with appropriate shift scheduling and reserve personnel assignment to minimize scheduled overtime

(d) all repairs, including preventive, corrective, and nonroutine maintenance

(e) a computerized maintenance management program

(f) cost accounting and a record keeping system to provide timely, accurate financial and budgeting data

(g) traffic control plan to monitor and record fuel receipts, ash, energy, and other commodity deliveries

(h) training program to enhance and develop employee skills, including employee evaluation and development programs

(i) a safety program, including an emergency response action plan

(j) a pollution control monitoring system to maintain air, wastewater, and noise control standards

(k) a quality assurance program with the appropriate checks and balances

(l) a disposal plan for residue and other waste materials

(m) regulatory agency interface

Next, we'll focus on the key features, skills, and management tools available from reputable service contractors, with special emphasis on the management, operation, and maintenance management aspects.

MANAGEMENT

Management, an encompassing word, is defined for the purposes of this paper to include:

(a) corporate support (administrative and technical)
(b) budgeting and cost controls
(c) project staffing
(d) training
(e) safety
(f) quality assurance
(g) communications

Corporate Support

It is imperative that the Service Contractor have a corporate staff of administrative and technical specialists to assist the project staff during start up with staffing, employee benefits, payroll, special procurements, insurance, technical issues, training, safety, and quality assurance programs.

Budgeting/Cost Controls

A few of the more important fiscal management tools are best illustrated by the following form samples:

(a) labor estimating program (Fig. 3)
(b) operations and maintenance budget (Fig. 4)
(c) annual budget (Fig. 5)

These reports will assist the facility operator in subsequent proposal efforts, annual budget planning, continuous cost monitoring and budget adjustments, in addition to development of a historic profile of the facilities operations and maintenance cost activities.

Project Staffing

Because the key to quality operations and management is quality people, proper staffing of a facility is synonymous with successful operations and management. Therefore, although corporate management is important in overall policy and finance decisions, the major player is the onsite Project Manager. The Project Manager's role in a new facility requires an in-depth knowledge of operations and maintenance of all system components as well as advanced people skills to deal with staff, owner, regulatory agencies, and the public. Ideally, the Project Manager should have the following minimum qualifications:

(a) 10 years of operations and maintenance with solid fueled boiler and turbine power generation systems, including 5 years of supervisory management

(b) certification as a stationary engineer and/or boiler operator

(c) demonstrated technical capabilities and knowledge

(d) strong oral and written communications capabilities

(e) extensive management and peoples skills

(f) training and safety expertise

(g) public relations experience

Project management takes a mature, dedicated, and highly motivated individual, a self-starter with a thorough understanding of the technology and how to motivate people to get the job accomplished in an efficient cost-effective manner.

The Project Manager will usually recruit his staff from local resources, with the possible exception of his operations and maintenance supervisory level positions. These positions require experience and background often not available in the local marketplace. A good operations management firm will be able to provide this expertise through their own key personnel or will have ready access to a number of potential qualified candidates.

The Organization Operations Diagram (Fig. 6) indicates the job classifications and staffing for a four-shift, 24 hr/day operating facility. The number of personnel and positions will vary with project size and complexities.

Recruiting and retaining a good staff is accomplished through proper evaluation of skills and experience, a sound employee orientation and fringe benefits program, incentives, such as bonuses or special recognition for exceptional performance, and adequate and well planned training programs. Treating employees like professionals and establishing a team effort creates a responsive, productive, and promotable staff.

Staffing may also require a reserve personnel labor pool, which is often personnel in training, who are used to reduce scheduled shift change overtime, in addition to vacation and sick leave relief. These are generally temporary or part-time employees.

Training

Training is an important element in retaining and developing staff. Operations and management firms must be able to provide the Project Manager with training materials and, if needed, special instructors for specific subjects.

Both onsite and formal classroom programs are combined to enhance operator skills and keep employees up-to-date on the latest techniques in operating and maintaining their facilities. The following summary covers typical training program requirements for a new project:

TRAINING REQUIREMENTS SUMMARY

Type of Training	Purpose
Orientation	Public relations and public information
Orientation	Employee orientation
Occupational Safety and Health Act (OSHA)	Employee safety orientation and education
Management Development	Supervisory development training for shift foreman and managers
Systems Operation	Train operators in the details of the process and system theory, e.g., water chemistry, SOPs, emergency conditions, etc.
Equipment	Train plant maintenance personnel in the check-out and repair of process equipment in accordance with the master preventive maintenance schedule and plan
Refresher Courses/Updates	Reacquaint all plant personnel with the SOP's in their functional work areas
CPR/Multi-Media	First aid - Red Cross or Heart Association certification

Safety

Safety must be one of the primary concerns in the operation and maintenance of all facilities. For instance, safety sessions rely heavily on employee input to identify and correct safety deficiencies; accident reports and debriefing procedures are used in investigating and evaluating past accidents. Involving employees in the design and implementation of safety programs makes safety a team effort and each employee's responsibility.

Emergency response is another key aspect of a safety program. Should any emergency or malfunction occur which threatens to overtax the onsite project staff,

						FRINGES								
						Insurance			Unemp.					Total Group
TITLE	M/S	RATE	#	GROUP SAL.	FICA	MEDICAL	LIFE	AD+D	STATE	FED	WORK COMP.	PENSION	TOT FRINGE	Sal.+Fringe
SALARIED	(1=Single)													
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
****HOURLY****														
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Total Jobs		0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Bonuses												TOTAL BONUS	$0
	Sched Overtime	0.0%		$0	$0						$0	$0	TOTAL O.T.	$0
	Pers. Reserve	0.0%		$0	$0						$0		TOTAL RESV	$0

PERCENT FRINGES = 0.00% TOTAL LABOR PLUS O.T. & RESERVES $0

MULTIPLIER TABLE

FICA	PERCENT	7.05
	LIMIT	$39,600
	MAX	$2,792
MED	AMOUNT/FAM	$1,686
	AMOUNT/SING	$553
	DENTAL	$330
LIFE	AMOUNT/M	0.20
AD+D	AMOUNT/M	0.06
STATE UNEMP	PERCENT	0.00
	LIMIT	$0
	MAX	$0
FED UNEMP	AMOUNT	$56
WORK COMP	PERCENT	0.00
PENSION	PERCENT	.00

FIG. 3 LABOR ESTIMATING PROGRAM

26-Oct-85

CONTRACT TITLE	PROJECT NAME		
TASK 0001 OTHER		% LABOR MARKUP	0%
5130-41 AUTO RENTALS	$0	% OTHER MARKUP	0%
5130-65 MOVING & RELOCATION	$0	% PROFIT	0%
5130-66 AIR TRAVEL	$0	BONUS AMT/EMP	$0
5130-67 AUTO MILEAGE	$0	STANDBY HRS/MO	0
5130-68 MEALS & LODGING	$0	AVG FLOW(MGD)	0.00
5130-69 ENTERTAINMENT	$0		
5140-20 ADVERTISING	$0	CONTRACT AMT=	$0
5140-60 VEHICLE EXPENSE	$0	OVERALL % MARGIN=	0.0
5140-61 LEASED AUTOS	$0		
5140-70 TELEPHONE & TELEGRAPH	$0		
5140-71 POSTAGE & FREIGHT	$0		
5140-72 OFFICE RENT	$0		
5140-73 EQUIPMENT RENTAL - INT	$0		
5140-74 OPERATING SUPPLIES	$0		
5140-75 OTHER UTILITIES	$0		
5140-77 EQUIPMENT RENTAL - OUT	$0		
5140-78 MISCELLANEOUS	$0		
5140-80 TOOLS	$0		
5140-81 CHEMICALS	$0		
5140-82 TAXES & LICENSES	$0		
5140-90 UNIFORMS EXPENSE	$0		
5140-91 MAINTENANCE SUPPLIES	$0		
5140-92 LABORATORY SUPPLIES	$0		
5140-93 FUEL OIL	$0		
5140-94 SAFETY SUPPLIES	$0		
5150-87 OUTSIDE SERVICES	$0		
5150-88 CONSULTANTS	$0		
5150-89 CONTRACT HAULING	$0		
5210-21 DUES & MEMBERSHIPS	$0		
5210-22 BOOKS & PUBLICATIONS	$0		
5210-23 TRAINING & TUITION	$0		
5210-24 MEETINGS & CONVENTIONS	$0		
5230-31 INSURANCE EXPENSE	$0		
5230-31 PERFORMANCE BOND	$0		
5240-76 NATURAL GAS	$0		
5240-77 ELECTRICITY	$0		
5240-78 WATER	$0		
TASK 0003 REPAIRS			
5140-77 EQUIPMENT RENTAL - OUT	$0		
5140-79 REPAIR PARTS	$0		
5140-91 MAINTENANCE SUPPLIES	$0		
5150-87 OUTSIDE SERVICES	$0		
TASK 0009 SOLIDS DISPOSAL			
5140-60 VEHICLE EXPENSE	$0		
5140-74 OPERATING SUPPLIES	$0		
5140-77 EQUIPMENT RENTAL - OUT	$0		
5140-79 REPAIR PARTS	$0		
5140-81 CHEMICALS	$0		
5140-93 FUEL OIL	$0		
5150-87 OUT SVCS(TIP FEE)	$0		
5150-89 CONTRACT HAULING	$0		
TOTAL	$0		

FIG. 4 OPERATIONS AND MAINTENANCE BUDGET

additional backup resources must be provided, often from corporate support.

Quality Assurance

In addition to staffing the facility with highly skilled, motivated people, operations and management should start with a quality assurance program covering all aspects of the process, i.e., operations, maintenance, laboratory services and cost control. One of the most valuable assets a good operations and management firm can bring to facilities are those previously proven techniques and process control technologies which will ensure optimal long-term operations and maintenance at the lowest possible cost. Setting high standards of quality control in all areas is one of the first steps towards ensuring a facility is operated properly, maintained effectively, and kept within budget. Coupled with a good solid team of operations and management specialists, quality assurance programs put in place during start up will serve to monitor, analyze, validate, track, and report on the whole system. Computerization has made these tasks much easier. The larger operations and management firms have automated operations and management programs designed with enough latitude to cover the major areas of facility operations, maintenance, laboratory, cost control, and productivity.

The heartbeat of any modern facility is in the computerized control center. The Project Manager will spend much of his time in this center monitoring the various stages of the operation through use of the computer controlled instrumentation and data readouts being fed into the main terminal logs, as well as reviewing reports from various operations such as the traffic coordinator's station.

Communications

Keeping the owner and corporate management abreast of important activities at his facility is not the only necessary communications link. State and local regulatory agencies take a keen interest in all facilities which could adversely impact the environment. Maintaining a good relationship with these agencies by compliance with regulatory permit requirements and submittal of the proper supporting documentation secures their confidence in the operations and maintenance firm's ability to stay within the permit parameters.

Reports covering air emissions, wastewater effluent quality, residue ash analysis, and any other regulatory requirements should be an integral part of the services provided by the operations and maintenance firm.

OPERATIONS

The term operations pertains to the integral system and process unit operations as they relate to system availability, reliability, and productivity. Operations

PROJECT NAME	ANNUAL BUDGET												
26-Oct-85	MO.1	MO.2	MO.3	MO.4	MO.5	MO.6	MO.7	MO.8	MO.9	MO.10	MO.11	MO.12	TOTALS
DIR SAL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
PERS RESV	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
OVERTIME	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
BONUSES	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
BENEFITS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-total	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
AUTO RENTAL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
MOVING & RELO	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
AIR TRAVEL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
AUTO MILEAGE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
MEALS & LDG	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
ENTERTAINMENT	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
ADVERTISING	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
VEHICLE EXP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
LEASED AUTOS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TELEPHONE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
POSTAGE & FRT	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
OFFICE RENT	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
EQ RENT IN	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
OPS SUPPLIES	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
OTHER UTIL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
EQ RENT OUT	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
MISCELLANEOUS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOOLS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CHEMICALS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TAX & LICENSE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
UNIFORMS EXP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
MTC SUPPLIES	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
LAB SUPPLIES	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
FUEL OIL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
SAFETY SUPL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
OUT SVCS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CONSULTANTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CONTRACT HAUL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
DUES & MEMBR	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
BOOKS & PUBS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TRNG & TUIT	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
MTGS & CONV	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
INSURANCE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
PERF. BOND	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
NATURAL GAS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
ELECTRICITY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
WATER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0003 REPAIRS													
EQ RENT OUT	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
REPAIR PARTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
MTC SUPPLIES	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
OUT SVCS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0009 SOLIDS DISPOSAL													
VEHICLE EXP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
OPS SUPPLIES	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
EQPT RENT-OUT	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
REPAIR PARTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CHEMICALS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
FUEL OIL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
OUT SVCS:TIP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CONTRACT HAUL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
LABOR MARKUP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
OTHER MARKUP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
PROFIT	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTALS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
% MARGIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

FIG. 5 ANNUAL BUDGET

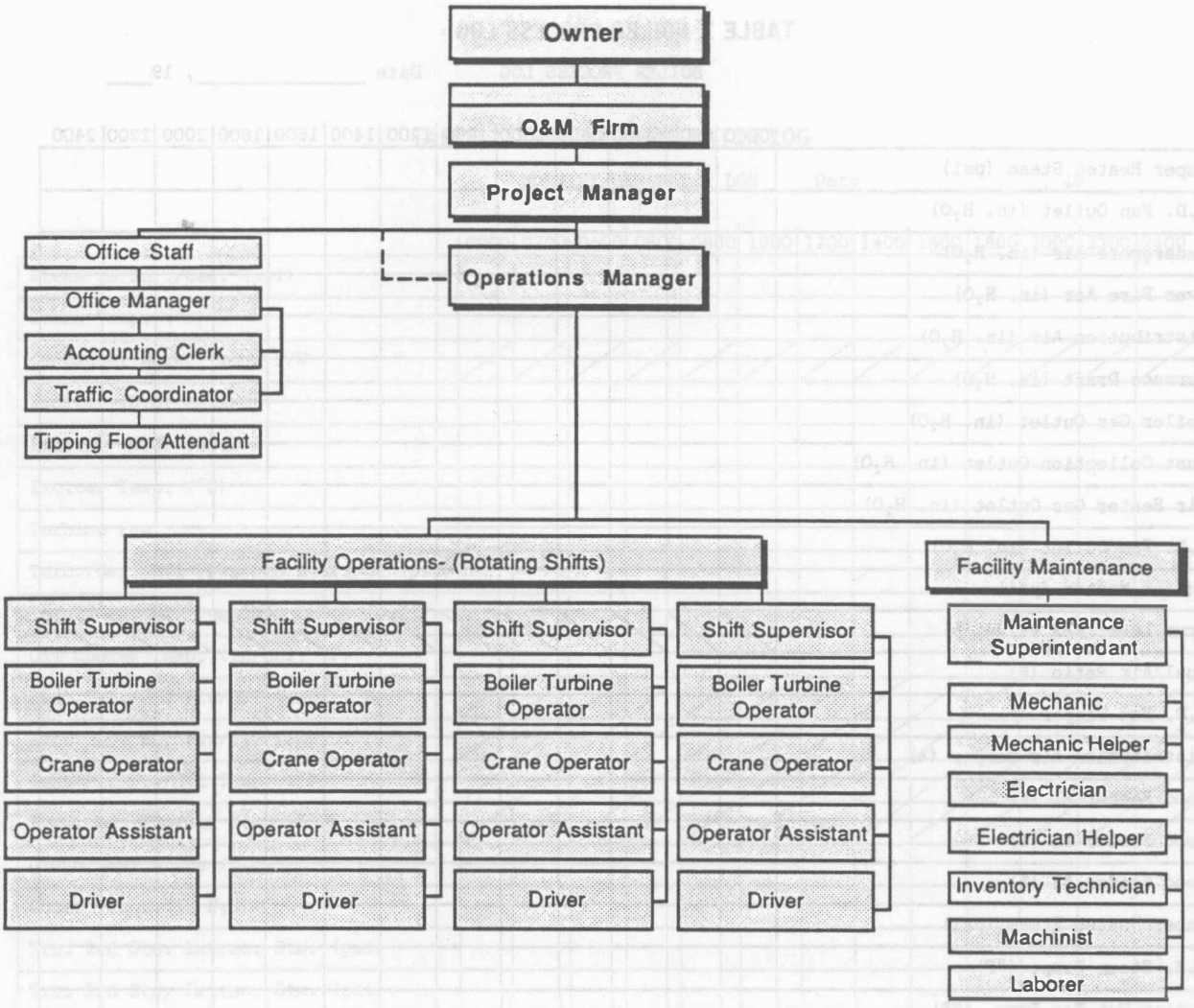

FIG. 6 ORGANIZATION-OPERATIONS DIAGRAM

are critically dependent upon the support of maintenance, to be discussed next as a separate but vital function. The combined operations and maintenance *team effort* is essential to maximize revenue production, the ultimate key to the project's success and the survival of the service contractor.

Operations are typically on a scheduled rotating shift basis. The shift foreman or supervisor usually assumes the facility management responsibilities for the period, with support from the project manager as required. During off shifts and weekends, they are supported by on-call maintenance staff for emergency repairs.

Operations are guided by extensive in-depth formal procedures, troubleshooting guides, records, and data logs, all of which are continually reviewed and upgraded to enhance the system reliability and efficiency as well as revenue production. These records and daily summary reports provide valuable information to management and the owner, and can highlight areas of pending difficulties.

Typical specimen logs used to monitor the various systems include:

(a) Boiler Process Log (Table 1)

(b) Turbine/Generator Log (Table 2)

(c) Daily Project Activities Summary Report (Table 3)

Logs and reports may be developed to fulfill the complexity of the system and contractual requirements. These reports are not only used to technically monitor the system, they are also used to determine

TABLE 1 BOILER PROCESS LOG

BOILER PROCESS LOG Date _____, 19____

	0000	0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200	2400
Super Heated Steam (psi)													
F.D. Fan Outlet (in. H_2O)													
Undergrate Air (in. H_2O)													
Over Fire Air (in. H_2O)													
Distribution Air (in. H_2O)													
Furnace Draft (in. H_2O)													
Boiler Gas Outlet (in. H_2O)													
Dust Collection Outlet (in. H_2O)													
Air Heater Gas Outlet (in. H_2O)													
I.D. Fan Outlet (in. H_2O)													
Boiler Master (psi)													
Drum Level F/W Valve (%)													
Fuel/Air Ratio (%)													
F.D. Fan Damper (%)													
Distribution Air Damper (%)													
Wood Feeder #1 (%)													
Wood Feeder #2 (%)													
Wood Feeder #3 (%)													
Super Heated Steam (psi)													
S.H. Steam Temp. (°F)													
Boiler Out Gas Temp. (°F)													
Air Heater Gas Out Temp. (°F)													
Feed Pump Discharge Press (psi)													
D.A. Tank Pressure/Temp. (psi/°F)													
Super Heater Steam Integrator (2400 Reading)													
24 hr. Steam Total													
24 hr. Softener #1 (gal.)													
24 hr. Softener #2 (gal.)													
Water Softener #1 (gal.)													
Water Softener #2 (gal.)													
Total Soft Water (gal.)													

fm2.85.008 (Remarks on Back)

TABLE 2 TURBINE/GENERATOR LOG

TURBINE/GENERATOR LOG Date _____, 19___

	0000	0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200	2400
Steam to Tur./Gen. (psi)													
Steam Temp. (°F)													
Condenser Water Temp. F/W													
Exciter (D.C. amps)													
Exciter (D.C. volts)													
Exciter Temp. (°C)													
Turbine rpm													
Turb./Gen. Oil Pres. to Bearings (psi)													
Turb./Gen. Oil Pump Discharge (psi)													
Oil Cooler Temp. (in/out, °F)													
Fwd. Trb. Br. Flw/Oil Temp. (°F)													
Aft. Trb. Br. Flw/Oil Temp. (°F)													
Gen. Br. Flw/Oil Temp. (°F)													
Exct. Br. Flw/Oil Temp. (°F)													
Gland Seal Steam (psi)													
Cond. Vacc. (in H_2O)													
Trb. 2rd Stg. Extrac. Stm. (psi)													
Trb. 3rd Stg. Extrac. Stm. (psi)													
Gen. Air Box Temp (°F)													
Air Box Water Temp. (in/out, °F)													
Condenser Water Temp. (in/out, °F)													
Ejector Steam (psi)													
Generator A.C. kilovolts													
Fl Pwr. A.C. kilovolts													
Fl Pwr. A.C. amps													
Generator A.C. amps													
Generator A.C. megawatts													
Generator kilowatts													
Fl Pwr. kilowatts													
24 hr. Gen. kilowatts (gross)													
24 hr. Fl Pwr. kilowatts (net sales)													

TABLE 3 DAILY PROJECT ACTIVITIES SUMMARY REPORT

1985	FUEL DELIVERIES		NET POWER SALES TO FPL				STATION LOAD			POWER PURCHASED from FPC							
NOVEMBER DATE (2400 hr READING)	NO. LOADS	TONS	ACCRUED BM to FPC METER READING	ACCRUED BM to FPC POWER-NET M/R x 700	CALCULATED DAILY NET SALES (KWH)	AVERAGE DAILY GENERATION RATE (net) (MW)	ACCRUED STATIONS METER READING	ACCRUED STATION POWER MR x 2400	AVERAGE STATION LOAD (KWH)	ACCRUED FPC to BM METER READING	ACCRUED FPC to BM NET MR x 700	PURCHASED POWER-kwh (MID)	SYSTEM GENERATION (Daily-hrs)	I R M	•••••••••••••• COMMENTS •••••••••••••• LIMITING PROD. FACTOR	EQUIP W/MECH DEFICIENCIES
0			39689.00	27782300	27782300	1157.60	1412.00	3388800	141200	299.00	209300	0	6.50			
1	6	144.40	39774.00	27841800	59500	2.48	1413.00	3391200	100	301.00	210700	1400	7.00		STARTUP @720	N/A
2	11	205.20	39946.00	27962200	120400	5.02	1418.00	3403200	500	305.00	213500	2800	24.00		WET FUEL	N/A
3	1	21.50	40104.00	28072800	110600	4.61	1424.00	3417600	600	305.00	213500	0	24.00		WET FUEL	N/A
4	10	220.30	40265.00	28185500	112700	4.70	1431.00	3434400	700	305.00	213500	0	24.00		WET FUEL	N/A
5	14	320.70	40446.00	28312200	126700	5.28	1437.00	3448800	600	305.00	213500	0	24.00		ADJUST TO COLD WEATHER	N/A
6	21	443.50	40665.00	28465500	153300	6.39	1444.00	3465600	700	305.00	213500	0	24.00		ADJUST TO COLD WEATHER	N/A
7	17	372.40	40830.00	28623000	157500	6.56	1450.00	3480000	600	305.00	213500	0	24.00		FUEL QUANTITY	N/A
8	13	263.00	41122.00	28785400	162400	6.77	1457.00	3496800	700	305.00	213500	0	24.00		FUEL QUALITY	N/A
9	6	118.50	41339.00	28937300	151900	6.33	1463.00	3511200	600	305.00	213500	0	24.00		FUEL QUALITY	N/A
10	0	0.00	41553.00	29087100	149800	6.24	1470.00	3528000	700	305.00	213500	0	24.00		SCREEN & CONVEYOR	SCREEN & CNVYR/SI RBR
11	11	234.90	41766.00	29236200	149100	6.21	1477.00	3544800	700	305.00	213500	0	24.00		FUEL QUALITY	N/A
12	13	284.90	41986.00	29339200	154000	6.42	1483.00	3559200	600	305.00	213500	0	24.00		FUEL QUALITY	N/A
13	13	294.30	42210.00	29547000	156800	6.53	1490.00	3576000	700	305.00	213500	0	24.00		FUEL QUALITY	N/A
14	17	364.90	42440.00	29708000	161000	6.71	1497.00	3592800	700	305.00	213500	0	24.00		MOISTURE CONTENT	N/A
15	12	240.30	42675.00	29872500	164500	6.85	1504.00	3609600	700	305.00	213500	0	24.00		FUEL QUALITY	N/A
16	6	114.90	42833.00	29983100	110600	4.61	1511.00	3626400	700	305.00	213500	0	24.00		LOW FUEL INVEN.	N/A
17	1	28.70	42947.00	30062900	79800	3.33	1517.00	3640800	600	305.00	213500	0	24.00		LOW FUEL INVENTORY	N/A
18	9	193.00	43062.00	30143400	80500	3.35	1523.00	3655200	600	305.00	213500	0	24.00		LOW FUEL INVENTORY	N/A
19	5	104.10	43214.00	30249800	106400	4.43	1529.00	3669600	600	305.00	213500	0	24.00		LOW FUEL INVENTORY	N/A
20	21	404.70	43400.00	30380000	130200	5.43	1534.00	3681600	500	305.00	213500	0	24.00		LOW FUEL INVENTORY	N/A
21	13	257.00	43460.00	30422000	42000	1.75	1541.00	3698400	700	312.00	218400	4900	13.00	46/47	AIR COMPRESSOR/STORM	AIR COMPRESSOR
22	4	85.50	43592.00	30514400	92400	3.85	1546.00	3710400	500	313.00	219100	700	23.50	48	STORM AND FL POWER SURGE	N/A
23	3	71.80	43692.00	30584400	70000	2.92	1552.00	3724800	600	314.00	219800	700	21.50	49	EXHAUSTED FUEL SUPPLY	N/A
24	0	0.00	43692.00	30584400	0	0.00	1557.00	3736800	500	315.00	220500	700	0.00		EXHAUSTED FUEL SUPPLY	N/A
25	4	73.20	43692.00	30584400	0	0.00	1558.00	3739200	100	319.00	223300	2800	0.00		EXHAUSTED FUEL SUPPLY	N/A
26	12	267.10	43692.00	30584400	0	0.00	1559.00	3741600	100	321.00	224700	1400	0.00		EXHAUSTED FUEL SUPPLY	N/A
27	12	248.20	43692.00	30584400	0	0.00	1560.00	3744000	100	324.00	226800	2100	0.00		EXHAUSTED FUEL SUPPLY	N/A
28	3	71.38	43777.00	30643900	59500	2.48	1564.00	3753600	400	326.00	228200	1400	16.00		START UP AT 0800	N/A
29	3	67.30	43987.00	30790900	147000	6.13	1571.00	3770400	700	326.00	228200	0	24.00		LOW FUEL SUPP. (CONSRV)	N/A
30	5	123.33	44133.00	30893100	102200	*4.26	1577.00	3784800	600	328.00	229600	1400	24.00		LOW FUEL SUPP. (CONSRV)	N/A
31			0	0	0.00		0	0		0	0					
TOTALS	266	5639.01			3110800	4.32						20300	595.00			

costs and revenues, and provide timely management and owner information.

In addition to computerized reports and logs, scheduled periodic reports should be generated to keep the owner and other project participants up-to-date. Such items as preventive maintenance and equipment repair status; scheduled outages or unscheduled down time at the facility; incidents which may have affected operations, safety, and perhaps costs; training meetings and safety inspections; general overview of the operations, as well as financial, budgetary, and cost variance should be reported periodically.

Most service contractors guarantee that effluent discharged from or products produced by the owner's waste treatment facility will meet all specifications of the plant's permits or agreements. While most experts agree that waste treatment and power generating plants can be operated in a number of different control modes so that effluent and air quality meet permit specifications, there are very few modes which can be termed "optimal." Wherever practical and feasible, process modifications (always with an eye toward operating economies and maximum revenues) are made at the owner's facility to produce the "optimal" control mode.

A plan for these modifications is written down and all personnel are instructed as to their particular roles in the implementation of this plan of action. Emergency procedures and safety techniques are included in each plan of action. This written plan of action ensures that the least costly method of operation will continue.

MAINTENANCE MANAGEMENT

A good maintenance program protects the large capital investment the owner has made in facilities and equipment. The service contractor must have the maintenance systems and experience to provide proper care for the facilities and equipment. In addition, maintenance specialists should have experience in the crucial start-up period where equipment failure rates can be high and rapid response is necessary.

Most reputable service contractors will implement a computerized maintenance system to provide all routine maintenance and to schedule and monitor preventive, remedial, and emergency maintenance as needed. The system should monitor, in detail, all those activities which reduce failures and extend the service lives of the facility and equipment. These activities include periodic lubrication, adjustments, visual inspections, and scheduled overhauls. The system should schedule each task and keep maintenance records to document equipment and system performance.

Primary emphasis should be given to the implementation of a preventive maintenance program. An equipment history file should be implemented and maintained, to assist in future capital planning and replacement decisions, as well as documenting compliance and new equipment warranty requirements. Other aspects of the maintenance program should include: (1) maintaining an adequate inventory of spare parts and tools; and (2) providing intensive mechanical maintenance training to employees.

A thorough maintenance program, when put in place at the time of start up, will help the owner realize the expected life span of its facilities or equipment, and safeguard against unnecessary replacement and failures.

Report Generation

The maintenance program output should include a series of predefined reports. These reports could be either printed out as hard copy on a printer or they could be displayed on the screen. The following tasks typify a well thought out computerized maintenance program. The samples provided were generated by the Computerized Operations and Maintenance Program (COMP's) developed by CH2M HILL.

PM Due Report (Fig. 7)

The PM Due Report is used to obtain information about the scheduled PM tasks which need to be performed on the plant's equipment. A report can be printed at any time for any due date desired. This report is most useful when printed out weekly.

Each PM procedure is assigned a priority and a craft code when the program is set up. This gives the user the ability to obtain PM Due Reports for tasks with a specific priority and/or craft code.

Another key feature of this report is that all procedures which are over 10% overdue are flagged to notify the maintenance worker of overdue tasks.

PM Overdue Report (Fig. 8)

The PM Overdue Report gives the maintenance manager a tool to monitor the ability of the maintenance crew to keep up with the scheduled PM. This report is essentially the same as the PM Due Report with the exception that it only includes the PM procedures which are over 10% overdue.

Equipment Task Report (Fig. 9)

The Equipment Task Report lists the PM procedures which have been designated for each piece of equipment.

Equipment Range: 5026497024 - 5027000000 Priority Range: 1 - 9 Due 07/15/85

Equipment ID / Task No.	Pri	PMP No. / PM Procedure	Over Due	Craft Code
5026497024		WOOD FEEDER NO. 1 DRIVE (N.)		
11	8	018 POWER POSITIONER DAILY PM	***	MECH
21	8	243 POWER POSITIONER WEEKLY PM	***	MECH
5026497034		WOOD FEEDER NO. 2 DRIVE (CNTR)		
11	8	018 POWER POSITIONER DAILY PM	***	MECH
21	8	243 POWER POSITIONER WEEKLY PM	***	MECH
5026497044		WOOD FEEDER NO. 3 DRIVE (S.)		
11	8	018 POWER POSITIONER DAILY PM	***	MECH
21	8	243 POWER POSITIONER WEEKLY PM	***	MECH
5026730015		FORCED DRAFT FAN		
11	8	401 CHECK FOR VIBRATIONS/EXCESSIVE NOISE	***	OPER
12	8	202 CHECK FOR EXCESSIVE BEARING TEMPERATURE	***	OPER
21	8	254 LUBRICATE STEADY REST BEARING(AQUA LUBE)	***	OPER
42	1	209 INSPECT DRIVE BELTS	***	OPER
5026730025		INDUCED DRAFT FAN		
11	8	401 CHECK FOR VIBRATIONS/EXCESSIVE NOISE	***	OPER
12	8	202 CHECK FOR EXCESSIVE BEARING TEMPERATURE	***	OPER
21	8	254 LUBRICATE STEADY REST BEARING(AQUA LUBE)	***	OPER
42	1	451 Lubricate Coupling (Lith BMPG)	***	OPER
5026797013		DISTRIBUTOR AIR DUMPER DRIVE		
11	8	018 POWER POSITIONER DAILY PM	***	MECH
21	8	243 POWER POSITIONER WEEKLY PM	***	MECH
5026797054		F. D. FAN DAMPER DRIVE		
11	8	018 POWER POSITIONER DAILY PM	***	MECH
21	8	243 POWER POSITIONER WEEKLY PM	***	MECH
5026797064		I.D. FAN DAMPER DRIVE		
11	8	018 POWER POSITIONER DAILY PM	***	MECH
21	8	243 POWER POSITIONER WEEKLY PM	***	MECH
5026820064		BOILER FD PUMP #1 DRIVE (N)		
31	4	551 VISUALLY INSPECT ELECTRICAL EQUIPMENT	***	ELEC
5026820065		BOILER FEED PUMP NO. 1 (N.)		
11	8	401 CHECK FOR VIBRATIONS/EXCESSIVE NOISE	***	OPER
12	8	202 CHECK FOR EXCESSIVE BEARING TEMPERATURE	***	OPER
21	8	434 CHECK/REFILL REDUCTION BOX OIL (OC 150)	***	OPER
5026820075		BOILER FEED PUMP NO. 2 (S.)		
11	8	401 CHECK FOR VIBRATIONS/EXCESSIVE NOISE	***	OPER
12	8	202 CHECK FOR EXCESSIVE BEARING TEMPERATURE	***	OPER
21	8	434 CHECK/REFILL REDUCTION BOX OIL (OC 150)	***	OPER
41	4	501 CHECK MOTOR-COUPLING ALIGNMENT	***	MECH
5026820115		TREATED WATER PUMP NO. 1 (N.)		
11	8	401 CHECK FOR VIBRATIONS/EXCESSIVE NOISE	***	OPER
12	8	202 CHECK FOR EXCESSIVE BEARING TEMPERATURE	***	OPER
5026820125		TREATED WATER PUMP NO. 2 (S.)		
11	8	401 CHECK FOR VIBRATIONS/EXCESSIVE NOISE	***	OPER
12	8	202 CHECK FOR EXCESSIVE BEARING TEMPERATURE	***	OPER

FIG. 7 PM DUE REPORT (07/15/85)

Equipment Range: 5026497024 - 5027000000 Priority Range: 1 - 9 Due 07/15/85

Equipment ID / Task No.	Pri	PMP No.	--- Equipment Description --- ---- PM Procedure ---	%Over Due	Craft Code
5026497024			WOOD FEEDER NO. 1 DRIVE (N.)		
11	8		018 POWER POSITIONER DAILY PM	3900	MECH
21	8		243 POWER POSITIONER WEEKLY PM	471	MECH
5026497034			WOOD FEEDER NO. 2 DRIVE (CNTR)		
11	8		018 POWER POSITIONER DAILY PM	3900	MECH
21	8		243 POWER POSITIONER WEEKLY PM	471	MECH
5026497044			WOOD FEEDER NO. 3 DRIVE (S.)		
11	8		018 POWER POSITIONER DAILY PM	3900	MECH
21	8		243 POWER POSITIONER WEEKLY PM	471	MECH
5026730015			FORCED DRAFT FAN		
11	8		401 CHECK FOR VIBRATIONS/EXCESSIVE NOISE	18000	OPER
12	8		202 CHECK FOR EXCESSIVE BEARING TEMPERATURE	18000	OPER
21	8		254 LUBRICATE STEADY REST BEARING(AQUA LUBE)	2485	OPER
42	1		209 INSPECT DRIVE BELTS	98	OPER
5026730025			INDUCED DRAFT FAN		
11	8		401 CHECK FOR VIBRATIONS/EXCESSIVE NOISE	18000	OPER
12	8		202 CHECK FOR EXCESSIVE BEARING TEMPERATURE	18000	OPER
21	8		254 LUBRICATE STEADY REST BEARING(AQUA LUBE)	2485	OPER
42	1		451 Lubricate Coupling (Lith BMPG)	98	OPER
5026797013			DISTRIBUTOR AIR DUMPER DRIVE		
11	8		018 POWER POSITIONER DAILY PM	3900	MECH
21	8		243 POWER POSITIONER WEEKLY PM	471	MECH
5026797054			F. D. FAN DAMPER DRIVE		
11	8		018 POWER POSITIONER DAILY PM	3900	MECH
21	8		243 POWER POSITIONER WEEKLY PM	471	MECH
5026797064			I.D. FAN DAMPER DRIVE		
11	8		018 POWER POSITIONER DAILY PM	3900	MECH
21	8		243 POWER POSITIONER WEEKLY PM	471	MECH
5026820064			BOILER FD PUMP #1 DRIVE (N)		
31	4		551 VISUALLY INSPECT ELECTRICAL EQUIPMENT	40	ELEC
5026820065			BOILER FEED PUMP NO. 1 (N.)		
11	8		401 CHECK FOR VIBRATIONS/EXCESSIVE NOISE	4100	OPER
12	8		202 CHECK FOR EXCESSIVE BEARING TEMPERATURE	4100	OPER
21	8		434 CHECK/REFILL REDUCTION BOX OIL (OC 150)	500	OPER
5026820075			BOILER FEED PUMP NO. 2 (S.)		
11	8		401 CHECK FOR VIBRATIONS/EXCESSIVE NOISE	4100	OPER
12	8		202 CHECK FOR EXCESSIVE BEARING TEMPERATURE	4100	OPER
21	8		434 CHECK/REFILL REDUCTION BOX OIL (OC 150)	500	OPER
41	4		501 CHECK MOTOR-COUPLING ALIGNMENT	64	MECH
5026820115			TREATED WATER PUMP NO. 1 (N.)		
11	8		401 CHECK FOR VIBRATIONS/EXCESSIVE NOISE	4100	OPER
12	8		202 CHECK FOR EXCESSIVE BEARING TEMPERATURE	4100	OPER
5026820125			TREATED WATER PUMP NO. 2 (S.)		
11	8		401 CHECK FOR VIBRATIONS/EXCESSIVE NOISE	4100	OPER
12	8		202 CHECK FOR EXCESSIVE BEARING TEMPERATURE	4100	OPER

FIG. 8 PM OVERDUE REPORT (07/15/85)

Equipment Range: 5026127014 - 5027000000 Priority Range: 1 - 9

Equipment ID	Task No.	Prior	PMP No.	--- PM Procedure ---	Craft Code
5026127014				TRUCK DUMPER PUMP #1 DRIVE (E)	
5026127015				TRUCK DUMPER PUMP NO. 1 (E.)	
5026127024				TRUCK DUMPER PUMP #2 DRIVE (W)	
5026127025				TRUCK DUMPER PUMP NO. 2 (W.)	
5026167013				TRUCK DUMPER	
5026291013				TRUCK WEIGH SCALES	
5026489013				FUEL CONVEYOR	
5026497024				WOOD FEEDER NO. 1 DRIVE (N.)	
	11	8	018	POWER POSITIONER DAILY PM	MECH
	21	8	243	POWER POSITIONER WEEKLY PM	MECH
	51	5	754	POWER POSITIONER SEMIANNUAL PM	MECH
5026497034				WOOD FEEDER NO. 2 DRIVE (CNTR)	
	11	8	018	POWER POSITIONER DAILY PM	MECH
	21	8	243	POWER POSITIONER WEEKLY PM	MECH
	51	5	754	POWER POSITIONER SEMIANNUAL PM	MECH
5026497044				WOOD FEEDER NO. 3 DRIVE (S.)	
	11	8	018	POWER POSITIONER DAILY PM	MECH
	21	8	243	POWER POSITIONER WEEKLY PM	MECH
	51	5	754	POWER POSITIONER SEMIANNUAL PM	MECH
5026730014				FORCED DRAFT FAN DRIVE	
	51	1	252	LUBRICATE MOTOR BEARINGS(ALUM)	OPER
	52	1	875	CLEAN MOTOR	ELEC
	53	1	776	CHECK MOTOR RUNNING AMPS	ELEC
	61	1	879	CHECK MOTOR INSULATION RESISTANCE	ELEC
5026730015				FORCED DRAFT FAN	
	11	8	401	CHECK FOR VIBRATIONS/EXCESSIVE NOISE	OPER
	12	8	202	CHECK FOR EXCESSIVE BEARING TEMPERATURE	OPER
	21	8	254	LUBRICATE STEADY REST BEARING(AQUA LUBE)	OPER
	42	1	209	INSPECT DRIVE BELTS	OPER
5026730016				FORCED DRAFT FAN V-BELT DRIVE	
5026730024				INDUCED DRAFT FAN DRIVE	
	52	1	875	CLEAN MOTOR	ELEC
	52	1	252	LUBRICATE MOTOR BEARINGS(ALUM)	OPER
	53	1	776	CHECK MOTOR RUNNING AMPS	ELEC
	61	1	879	CHECK MOTOR INSULATION RESISTANCE	ELEC
5026730025				INDUCED DRAFT FAN	
	11	8	401	CHECK FOR VIBRATIONS/EXCESSIVE NOISE	OPER
	12	8	202	CHECK FOR EXCESSIVE BEARING TEMPERATURE	OPER
	21	8	254	LUBRICATE STEADY REST BEARING(AQUA LUBE)	OPER
	42	1	451	Lubricate Coupling (Lith BMPG)	OPER
5026730026				INDUCED DRAFT FAN COUPLING	
5026750707				BOILER CONTROL PANEL	
5026763013				ROTARY SEAL FEEDER NO. 1 (N.)	
5026763014				ROTARY SEAL FDR #1 DRIVE (N)	
5026763023				ROTARY SEAL FEEDER NO. 2	

FIG. 9 EQUIPMENT TASK REPORT (07/15/85)

```
Equipment Range: 041210  -  041210
================================================================================
Equipment ID: 041210          Description: Sec Clar #1 Drive Mechanism

Manufacturer: Envirex                                  Supplier: G.T. Morris
Model No.: H-40LT                                                2020 Lost Creek Dr.
Serial No.: H-116237                                             Salem          OR
Initial Cost: 15000      Catalog ID: A12                                    97288
Startup Date: 03/17/78   Drawing ID: S8                                 503/292-9292
--------------------------------------------------------------------------------
General
 80'-0" Diameter Tow-Bro w/ Skimming : Flow (MGD) - 2.016 Max,.504 Min :
 Velocity (FPS) - 2.657 Max, .664 Min : Headloss - .839 FT Max :

--------------------------------------------------------------------------------
Recommended Spare Parts

 DCH  Drive Chain                    SPR  Drive Sprocket
 WMG  Worm Gear                      WRM  Worm
 VPG  Vent Plugs (Set)               SQG  Squeegees for Scraper Arm
 DBD  Deflector Blade                MSW  Torque Overload Micro Switches
```

FIG. 10 EQUIPMENT DATA REPORT

Equipment Information Report (Fig. 10)

The Equipment Information module contains specific information on each piece of equipment in the program. This includes such information as the supplier, recommended spare parts, serial number, startup date, catalog number, and nameplate data. This module provides a place to store away a large amount of "equipment information" which can be easily misplaced or lost. The Equipment Data Report sample shown in Fig. 10 summarizes all of the information input into the program on a specific equipment item. It is an extremely useful tool which makes it easy to find information that would normally be in more than one place.

PM Procedures Report (Fig. 11)

This report shows the tools required, materials required, and special instructions for performing each PM procedure. This gives plant staff a place to document helpful hints, lubricant types, safety procedures, and useful tools which will help in performing the specific PM procedures, making the job easier and safer. New experiences need to be recorded, and added through the PM Procedure Updates section of the program.

Work Order Reports

The work order program defines all maintenance tasks in the plant as one of two types: planned or scheduled maintenance, and breakdown or corrective maintenance. All breakdown or corrective maintenance is defined as Work Orders.

The program contains a module which allows the plant staff to enter specific information from work orders which have been performed. This information provides the staff with information which can aid in identifying problem equipment and costs associated with work orders. The following two reports are generated from this program.

Work Order History Report (Fig. 12)

This report lists all of the work orders performed for a specific equipment item. Information included with each work order is the work order ID, description of work performed, hours worked, and materials cost.

This is a very easy way to search through years of work orders and quickly come up with the ones performed on specific equipment. All of the original work orders should still be filled in case more specific information is needed. These can be easily found if filed in logical order of work order ID.

Work Order Summary Report (Fig. 13)

This report tells the total number of work orders performed on a piece of equipment over the designated data range. Also included is the total labor cost, materials cost, initial equipment cost, and total maintenance cost/initial equipment cost (TC/IC) factor.

This report is very useful in identifying problem or high maintenance equipment. The TC/IC Factor shows the relative cost of work order maintenance to the equipment's value, providing justification for replacement of high maintenance items.

```
PM Procedure Range:  001    -  010
================================================================================

PMP NO.: 001        Description:   INSPECT FOR UNUSUAL NOISE OR VIBRATION

Craft Code: OPER                          Time Required:
Tools Required

Materials Required

Special Instructions

PMP NO.: 002        Description:   INSPECT FOR EXCESSIVE HEAT

Craft Code: PTWKR                         Time Required: .2
Tools Required

Materials Required

Special Instructions

PMP NO.: 003        Description:   RECORD PUMP RUNNING HOURS

Craft Code: OPER                          Time Required:
Tools Required

Materials Required

Special Instructions

PMP NO.: 004        Description:   CHECK OPERATION OF CHECK VALVE

Craft Code: OPER                          Time Required:
Tools Required

Materials Required

Special Instructions

PMP NO.: 005        Description:   CHECK OPERATION OF BUBBLER SYSTEM

Craft Code: OPER                          Time Required:
Tools Required

Materials Required

Special Instructions
```

FIG. 11 PM PROCEDURES REPORT (07/15/85)

Equipment Range: 011111 - 012410 Start Date: 01/01/83 End Date: 08/25/83

Equipment ID	Work Order ID	Date WO Closed	Work Order Description	Man Hours	Parts Cost
011111	A002103	01/25/83	Replaced upper motor bearing	8.0	75
011111	A002298	03/10/83	Replaced lower motor bearing	10.0	75
011112	A002159	02/12/83	Rebuilt Impeller	12.0	350
011122	A002321	03/15/83	Rebuilt Impeller	8.0	350
011510	A002386	03/22/83	Unplugged fuel pump	2.0	0
012111	A002468	04/22/83	Rewound motor	4.0	450
012121	A002470	06/22/83	Replaced shaft sleeve	8.0	115
011510	A002503	05/03/83	Replaced tach	4.0	230

FIG. 12 WORK ORDER HISTORY REPORT

Equipment Range: 011111 - 012510 Start Date:01/01/78 End Date:08/25/83

Equipment ID	No. of WO's	Labor Cost	Parts Cost	Total Cost	Initial Cost	TC/IC
011111	4	$ 353	$ 190	$ 543	$ 850	0.64
011112	2	$ 154	$ 415	$ 569	$ 775	0.73
011113	1	$ 30	$ 0	$ 30	$ 950	0.03
011121	1	$ 45	$ 12	$ 57	$ 850	0.07
011122	2	$ 160	$ 395	$ 555	$ 775	0.72
012112	3	$ 145	$ 227	$ 372	$ 775	0.48
012121	1	$ 74	$ 184	$ 258	$ 850	0.30
012210	1	$ 35	$ 110	$ 145	$ 105	1.38
012510	3	$ 156	$ 447	$ 603	$ 8900	0.07

FIG. 13 WORK ORDER SUMMARY REPORT

Hardware and Software Selection

The operations contractor should carefully select the computer hardware so it will meet the needs of the plant. They should be certain the disk storage capacity is large enough to handle their total data base and also keep computer uses other than maintenance management in mind when selecting their system. Other uses could include:

(a) inventory control
(b) process control
(c) monthly monitor reporting
(d) word processing

The contractor should always keep in mind that the proper hardware is essential to operate their software, yet the software must be able to provide the desired results.

SUMMARY

Reputable service contractors provide comprehensive operations and maintenance services, including but not limited to:

(a) project administration
(b) organization of project team
(c) employee motivation
(d) total staff training
(e) maintenance management
(f) quality assurance
(g) process optimization
(h) budgeting and cost control mechanisms
(i) client-contractor communications network
(j) public awareness programs
(k) safety procedures/training/emergency response program

(l) computerized management tools

Key features to consider in selecting a service contractor should include a firm with:

(a) experience in similar projects
(b) professional motivated employees
(c) high quality, low cost service
(d) a flexible approach to project needs
(e) a strong preventive maintenance program
(f) strong contractor-client communications

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