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Chapter 4. Annual Work Plan

4.1 Introduction

a. In a 1998 commissioned study (Appendix C, resource 31) addressing the inadequate funding of Government facilities maintenance and repair, the National Research Council (NRC) concluded that agencies' facilities M&R programs were underfunded relative to their CRV, noncompetitive with operations programs, inconsistent between Agencies, overextended, mismanaged, and difficult to quantify and justify, and their funding was often and easily diverted. A well-conceived and comprehensive AWP will clearly substantiate the need for good, strong, and well-articulated justification for requesting, managing, and properly allocating M&R funds for the responsible stewardship of NASA facilities.

b. NASA has adopted a maintenance philosophy that emphasizes using the optimal mix of strategies to provide required facility availability and reliability at minimum cost in supporting current and planned NASA programs. This chapter emphasizes the use of Reliability Centered Maintenance program data in identifying long- and short-range facility requirements based not only on mission impact, but on ensuring that NASA maintenance programs continue to progress toward proactive modes of operation versus reactive modes. A template for preparing an Annual and Five-Year Maintenance Work Plan is provided in Appendix H.

c. The AWP is a tool used by the facilities maintenance manager for the following purposes:

1. To justify funding for the maintenance and repair of facilities and equipment in an organized manner for presentation to the Congress and others.

2. To identify, with a reasonable degree of accuracy, the Center's DM.

3. To ensure that all resources are used effectively to provide Center maintenance support in a manner that reflects priorities relative to mission criticality.

4.1.1 A well-developed AWP will provide a guide for the year's activity to ensure that

NASA Center priorities are followed and the maintenance program progresses in a proactive versus a reactive mode of operation. Excessive reactive maintenance requires correspondingly excessive maintenance management that could be better spent in program planning, proactive maintenance, work evaluation, and analysis of resource expenditure effectiveness. The AWP balances estimated emergency and urgent reactive maintenance with predefined RCM activities such as PGM, PT&I, PM, and proactive maintenance. The plan shall promote the adoption of new maintenance technologies and document the maintenance requirements for the year.

4.1.2 The added value of the AWP to the facilities maintenance program is in providing a sense of direction that the maintenance workforce can follow, thereby defining their contribution to the organization's accomplishments and enabling them to be more productive. The baseline of work defined by the AWP is then used together with the metrics and benchmarking methodology discussed in Chapter 3, Facilities Maintenance Management, and in Appendix G to evaluate progress and guide future efforts.

4.1.3 The AWP should be prepared prior to the start of the fiscal year and be ready to execute on schedule. Work that is necessary but unfunded through the regular budget and alternative funding should be identified where possible. Work that is still necessary and unfunded at the end of the fiscal year is added to the DM and monitored for later funding. The AWP must be a flexible working document, incorporating changes throughout the year to accommodate emerging mission and customer requirements and requirements identified during facility condition assessments that cannot wait for the next budget cycle.

4.2 The Link between Planning and Execution

4.2.1 Based on the previously gathered information about the Center, the AWP can be developed into the foundation of the maintenance management program. The AWP links the total maintenance requirements, as analyzed and prioritized, and integrates the budget constraints with day-to-day work control and work execution. This linkage is shown in Figure 3-2.

4.2.2 Before an AWP can be prepared, the facilities maintenance manager must understand the mission of the Center and the impact of facilities condition on that mission. Because of the nature of the overall NASA scientific mission, its continual change must be taken into consideration. Important long-range plans such as the Center Master Plan, Five-Year CoF Plan, and Five-Year Maintenance Plan (see paragraph 4.8, Five-Year Facilities Maintenance Plan) are dynamic and must be updated annually as the AWP is developed. Further, facility requirements change as individual customers, supervisory direction, and missions change.

4.2.3 Short-term changes also have an impact on maintenance. The AWP must be flexible enough to accommodate these changes without invalidating the basic plan structure. The following are examples:

a. A change in a specific supporting research task may allow the use of alternative facilities rather than requiring an expensive alteration.

b. Scientific operations could preempt previously scheduled work in a given facility for a period of time, thereby causing a delay in a programmed maintenance project.

c. A change in a test program may demand more reliable power for a particular testing period, thereby requiring more preventive or predictive maintenance than normally programmed.

d. The criticality of a specific scientific project or support to a space flight could necessitate scheduling a special maintenance activity before the launch.

4.3 Content

4.3.1 The AWP is a compilation of all maintenance and repair work to be accomplished

during the year, including an estimate for unforeseen work. This compilation is the result of analyzing the total work requirements and integrating them with the budget, as shown in Figure 3-2.

4.3.2 Figure 4-1 shows the specific elements making up a facilities maintenance AWP. Each element can be developed and considered as a separate entity. (In the figure, PM and PT&I are separated by a broken line because PT&I is considered a subset of PM. The same is true of Repairs and TCs. Cumulatively, the elements define the total facilities maintenance program planned at a Center for a given year and the estimated cost in dollars and other resources (i.e., labor, materials, and equipment). However, note that only routine maintenance and repairs are included as part of NRC's 2- to 4-percent of CRV recommended maintenance budget.

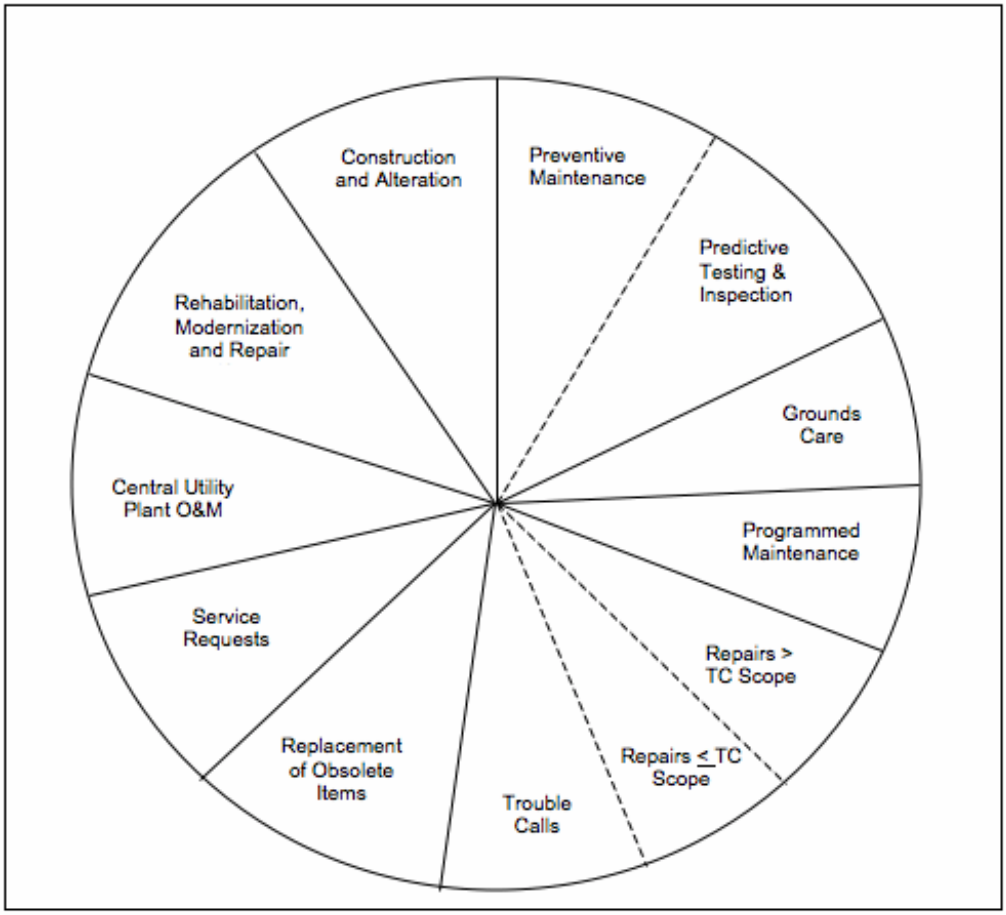

Figure 4-1 Facilities Maintenance Annual Work Plan Elements

4.3.3 The AWP should include an estimate and allowance for reimbursable work. This is to ensure that reimbursable work will complement rather than compete with necessary maintenance work.

4.3.4 The dollar limits for a work package in each facilities maintenance work element are shown in Table 2-2. CoF projects, although not normally executed by the maintenance organization, are documented in the AWP to ensure coordination of construction and maintenance activities. Besides a listing of projects to be accomplished, the AWP should document any pertinent maintenance-related information that was identified during the design and development of the CoF projects.

4.4 Information Sources

4.4.1 Preparing an AWP requires specific information. The facilities and collateral equipment inventory, coupled with the RCM database (see Section 4.6.4), constitutes the basic information needed. Such an inventory database should be augmented by a variety

of files and other key documents, including mission statements and objectives from the NASA and Center Strategic Plans and other policy documents, PM requirements, a continuous inspection program, historical funding data, Energy Efficiency and Water Conservation Five-Year Plan (Appendix C, resource 10), and facilities history records. The CMMS is a valuable source of information on facility and equipment maintenance histories, criticality codes, priorities, performance metrics, TC histories, and other unforeseen requirements on which to base a reasonable estimate of the required level of effort for each season of the year. See Appendix H for additional information on suggested information sources.

4.4.2 The NASA Strategic Plan and Center Mission Statements. Pertinent excerpts from these documents set the stage for justifying to Congress and others why funding is required and the ramifications to big-picture Government interests if the funding is not provided. From their guidance, the AWP should identify and illustrate why short- and long-term facilities maintenance funding is crucial to ensuring facility availability for NASA's critical missions. The AWP builds on the mission statements to provide guidance on setting priorities based on facilities and equipment criticality relative to mission, current condition, and long-range plans that will affect real property assets and future maintenance requirements.

4.4.3 Center Master Plan and Other Planning Data. This planning documentation will identify not only future construction, acquisition, and disposal plans for the Center that will ultimately impact maintenance and resource requirements, but will also identify other short- and long-range planning information, such as anticipated civil servant and contractor staffing requirements and opportunities for interservice support agreements. Information such as the expected staffing population is important to the AWP in that it is indicative of the level of work being performed at the Center at any time and can provide justification for adequate maintenance funding.

4.4.4 RCM (PM/PT&I) Database. This database, usually found in the CMMS, is required to develop PM and PT&I funding requirements for the next five years, including all labor, parts, materials, and special tools. RCM may identify the most effective maintenance in terms of retaining the highest reliability at the lowest cost. It may even recommend that no maintenance action be taken on specific items, appearing contradictory to traditional maintenance philosophies. The RCM and PM/PT&I databases should provide the following:

a. Inventory of maintainable items.

b. Facility and equipment criticality and condition codes.

c. Specific inspections and maintenance tasks to be performed on each maintainable item of unattended, maintainable collateral equipment. These are periodic tasks to keep equipment items in good operating condition for improved reliability and to maximize their service lives.

d. The parameter (e.g., maximum allowable pressure drop, maximum allowable bearing temperature, recommended time interval between PM/PT&I service) defining when each PM/PT&I task should be performed.

e. The estimated resources required to perform each PM/PT&I task in terms of work hours (by craft), materials, tools, and equipment. The total of these estimated resource requirements becomes the basis for the PM/PT&I portion of the AWP, workforce staffing, and work scheduling. Also, these estimates can be used to balance the program.

f. Specific instructions for obtaining condition assessment information as part of each maintainable collateral equipment PM/PT&I. The information to be recorded includes the condition of the overall item of equipment and, in some cases, of a part or subsystem of the equipment item. Instructions should also define a procedure for describing and documenting the results of the condition assessment.

4.4.5 Facilities/Equipment History Database

4.4.5.1 Concurrent recording within the historical database of the condition of the items receiving PM/PT&I is one important product of the PM and PT&I programs. A continuous inspection program should be established to provide a basis for determining PGM and repair requirements for items such as roofs, doors, walls, and windows that are not included in the PM or PT&I programs.

4.4.5.2 Once the facilities inventory is in place, it must be updated continuously to keep the inventory current and to maintain a detailed record of facilities condition. This is accomplished using the continuous inspection program. Historical files are a repository for all of the information on inventory items that is useful in preparing an AWP. These files must be structured carefully so that they include all necessary data, including the following:

a. Records of PM and PT&I work accomplished (i.e., identifying work completed, dates of performance, and costs in work hours and dollars).

b. Records of PGM and repair work accomplished (i.e., identifying PGM and repair work done, dates of work performance, and costs in work hours and dollars).

c. Condition assessment information developed during maintenance work.

d. Condition assessment information developed during the continuous inspection program.

e. Designation of candidate items for ROI.

f. Designation of candidate items for disposal or declaring excess.

4.5 Structure and Interrelationship of AWP Elements

4.5.1 Preventive Maintenance. The PM requirements for maintainable collateral equipment items are defined using manufacturers' recommendations, R.S. Means Cost Data or similar guides, historical information, the technical expertise and experience of the maintenance staff, task and periodicity guidance from other Centers for like equipment, and other sources. After defining and summarizing the PM requirements relative to the work standards and identified tasks, their estimated costs in work hours and dollars for a fiscal year will be calculated. These totals define the level of effort (i.e., labor and funds) required to accomplish the unconstrained PM program. Those figures would then be evaluated in terms of projected facilities maintenance funding and labor levels and the estimated requirements for the other elements of the AWP. Such an evaluation is used to establish target resource allocations for the PM program on an annual basis during the five-year planning period. See Table 2-2 for dollar limitations.

4.5.2 Predictive Testing & Inspection. PT&I involves gathering condition data on potential sources of failure. A PT&I program provides some of the condition data needed to carry on other elements (e.g., PGM or repair) of an AWP. Because it entails a dedicated effort drawing upon facilities resources, PT&I is an element of the AWP. PT&I can greatly impact an AWP because it extends the reach of the inspection program. For example, vibration analysis of a generator might be the basis for either accelerating or deferring a scheduled major overhaul. Or, infrared testing of a roof might indicate the need for small repairs now and avert a major CoF repair project in the future. See Table 2-2 for dollar limitations.

4.5.3 Grounds Care. Grounds care normally is accomplished with a relatively constant level of effort during the growing season. The level of effort can be predicted with a high degree of accuracy. See Table 2-2 for dollar limitations.

4.5.4 Programmed Maintenance

4.5.4.1 PGM work refers to recurring work performed at longer than one-year cycles and is best laid out in the Five-Year Maintenance Plan. It involves predefined, specific work tasks. PGM work schedules often are determined on the basis of actual conditions, rather than by fixed intervals. Because of this reliance on condition data to schedule PGM tasks, a continuous inspection program that includes PT&I and user input is required. See Table 2-2 for dollar limitations.

4.5.4.2 Condition codes should be established and recorded in the RCM and facilities history databases for each applicable inventory item maintenance function. They should be structured to trigger the identification of candidate PGM work when a certain condition level is recorded through the PT&I and continuous inspection programs.

4.5.4.3 Candidate PGM work can be costed and evaluated for programming in a particular annual program on the basis of projected funding levels. It is a case of analyzing all of the PGM requirements against other AWP requirements and allocating resources based on priorities. Work can be accomplished by civil service employees, incumbent support service contractors (if the work is determined to be within the scope of the contracts), or by a separate new contract.

4.5.5 Repair

4.5.5.1 Repair implies urgency because it involves fixing something broken or failing. It is work planned and executed as a single function, e.g., replacing a boiler or repairing leaking tanks. Repairs can be further divided into two categories: (1) repair as a result of PT&I (scheduled), and (2) repair as a result of breakdowns (unscheduled). Non-CoF repair work must be within the Center Director's funding authority. See Table 2-2 for dollar limitations.

4.5.5.2 Repair requirements are identified from the RCM and continuous inspection programs, including input from users, occupants, and facility maintenance personnel. A clear distinction cannot always be made between PGM and repair. For example, pavement sealing and painting of entire structures are considered PGM, but repairing potholes and spot painting are considered repair. As a rule of thumb, repair usually involves fixing portions of an overall facility or system, whereas PGM involves some restoration of the entire system.

4.5.5.3 Local replacement criteria should be established. For example, barring extenuating circumstances, an item should be a candidate for replacement rather than repair if the repair cost exceeds 50 percent of the replacement cost.

4.5.6 Trouble Calls. TCs address items that break or are damaged unexpectedly. While a facilities maintenance manager uses the historical information in the CMMS to estimate in the AWP the expected level of TC effort, the manager should adjust the estimate upward to reflect inflation and physical plant additions or downward to reflect improvements in the maintenance program and decreases in the size of the physical plant. See Table 2-2 for dollar limitations.

4.5.7 Replacement of Obsolete Items. ROI requirements are identified through a variety of sources, particularly RCM analysis. For example, trends indicating that several same-year, same-model mechanical units used in a particular application are likely to fail in the near future may be indicative that the best course of action would be to replace all of them, regardless of past individual maintenance history; the breakdown of one of several same-model pumps may lead to the discovery that parts are no longer available for that pump; PM inspection reports may identify equipment items failing to meet new electrical code requirements; or manufacturer's data for a newly purchased pump may indicate that similar onsite pumps are no longer parts-supportable. RCM database and equipment history files need to be structured and procedures established to recognize this type of information and to flag the associated equipment item as an ROI candidate. The facilities maintenance manager can then prioritize ROI candidates and evaluate them for replacement on the basis of safety and operational impact. See Table 2-2 for dollar limitations.

4.5.8 Service Requests. Small service requests are often performed by the same organization that performs TC work. While service requests are nonmaintenance work and do not fit within NRC's 2- to 4-percent of CRV suggested funding, small service requests are similar to small TCs in that they consist of minor facilities support work needed to maintain routine installation operations. An analysis of the TCs accomplished and the service request records identifies the relative levels of effort allocated to each of these similar elements of the AWP. Caution must be exercised to ensure that service request

work does not take disproportionate precedence over important maintenance work. Normally, outside contractors perform work generated by large service requests. Service request work includes facilities construction and additions costing less than the CoF $500,000 threshold (unless the CoF process as outlined in NPR 8820.2 is followed). See Table 2-2 for dollar limitations.

4.5.9 Central Utility Plant Operations and Maintenance. Central utility plant O&M normally requires a nearly constant level of effort (depending on the season), adjusted for inflation, and the addition or deletion of facilities. See Table 2-2 for dollar limitations.

4.5.10 Rehabilitation, Modification, Repair, Construction, and Additions. Rehabilitation, modification, repair, construction, and additions are CoF categories described in NPD 8820.2, Design and Construction of Facilities; NPR 8820.2, Facility Project Requirements; and NPD 7330.1, Approval Authorities for Facilities Projects.

4.6 Five-Year Facilities Maintenance Plan

4.6.1 Facilities maintenance organizations in both the public and private sectors widely accept the concept of an AWP as an aid for both the budgetary and the work-execution processes. The AWP can assist the facilities maintenance manager in establishing goals within projected resources and in planning to meet those goals. The AWP should evolve from a multiyear plan derived from a complete and continuously updated list of facilities requirements as shown in Figure 3-2. Such multiyear planning promotes achieving long-range goals and consistent direction in facilities maintenance management.

4.6.2 The Five-Year Maintenance Plan is based on the total maintenance requirements, which in turn, are based on mission, criticalities, and established standards. This plan provides the necessary information for budget forecasting and initial planning and preparation of the AWP (see paragraph 4.6.1). This procedure ensures that the highest priority of maintenance work is scheduled and not lost in the budgeting process. The plan should provide a balance of RCM to minimize the deferral of maintenance along with a realistic estimate of emergency and routine maintenance and repair. The plan should provide for the management of the DM such that the DM is controlled by a steady reduction of requirements or stabilized within the locally established guidelines of the Center.

4.6.3 Appendix H provides a template for producing Five-Year and Annual Maintenance Plans. The Five-Year Maintenance Plan is the result of a conscious evaluation of the NASA Strategic Plan, Center Master Plan, Five-Year CoF Plan, and mission goals of the Center. A well-developed and up-to-date Five-Year Maintenance Plan ensures that major maintenance repair or replacement is not wasted by the execution of a large CoF project or facility-use change. Further, additional PM and PT&I funding can be programmed in advance to accommodate new growth and mission changes. This will ensure immediate and continued maintenance of new facilities as they come on line, thereby reducing future deterioration and premature failures.

4.7 Facilities Work Requirements

4.7.1 Total Requirements

4.7.1.1 An elusive goal of facilities maintenance managers is to develop and maintain a system to define a complete, unconstrained list of all existing and predictable facilities maintenance work requirements. Such a list should include not only the DM but also current and continuing requirements for PM, PT&I, Grounds Care, PGM, Repair, TCs, ROI, and projections for new work to respond to evolving organizational and facilities maintenance requirements.

4.7.1.2 The total requirements should include estimates of unforeseen work that has a high degree of predictability (e.g., weather-related events, such as thunderstorms and snowstorms). These requirements can easily add up and, unfortunately, are performed at the expense of routine maintenance, thereby increasing the DM. When this unforeseen

work is quantified and programmed, it can be used to reduce DM during years when the unforeseen work is light.

4.7.1.3 The total maintenance requirements (shown in Figure 3-2), both identifiable and unforeseen, can be compiled as a list or database to serve as the basis for defining the Five-Year Facilities Maintenance Plan and the AWP. The database would then contain all potential facilities maintenance work. Thus, it should be the task of the facilities maintenance manager to use the database to construct the balanced AWP that most effectively responds to conflicting priorities within programmed resources.

4.7.2 Deferred Maintenance

4.7.2.1 The DM, formerly known as "Backlog of Maintenance and Repair (BMAR)," is the total of essential, but unfunded, facilities maintenance work necessary to bring Centers to the required facilities maintenance standards. It is work that should be accomplished during the year but cannot be accomplished within available resources. It does not include new construction, additions, or modifications, but does include unfunded CoF repair projects.

4.7.2.2 DM is an excellent indicator of the condition of Center facilities and collateral equipment. It reflects the cumulative effects of underfunding facilities maintenance and repair. Review of DM trends and comparison of DM with the CRV and facilities maintenance funding provide indications of the adequacy of the resources devoted to facilities maintenance.

4.7.2.3 An annual reevaluation of the DM is necessary for the development of the AWP. This not only authenticates the work that continues to be deferred as DM, but it also identifies work items in the DM covering deficiencies that have progressed to the point where they need to be included in the AWP. See Chapter 9, Deferred Maintenance, for a more detailed discussion on DM.

4.8 Resources

4.8.1 While most AWP preparation focuses on defining the requirements and matching those requirements to projected funding levels, the personnel resources required to execute an AWP are also a critical aspect of the planning process. The timely mobilization of personnel with the requisite skills is a complex task. Generally, three categories of personnel are available to execute the AWP: Civil service personnel, support services contractors, and outside contractors.

4.8.2 As the Five-Year Facilities Maintenance Plan evolves, the facilities maintenance manager should explore alternatives for matching projected work with personnel resources. The earlier the manager can define the work requirements, the more efficient mobilization of those resources can be. For example, if the Five-Year Facilities Maintenance Plan indicates that electrical work will exceed current shop resources in three years, the manager can take steps early to adjust the support services contract or identify specific work to be performed by outside contractors.

4.8.3 The construction of new or altered facilities also may increase maintenance work requirements that should be planned for in advance. Otherwise, when the new or expanded facilities are accepted, there may be insufficient maintenance resources to accommodate them. This often leads to premature failures since no maintenance is provided for the new facilities, thereby increasing the life-cycle cost of facilities and equipment. Over time, this can also result in additions to the DM.

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