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FEED MATERIALS PRODUCTION CENTER

FINAL PHASE-IN REPORT

VOLUME 1 OF 15

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OPERATIONS AND MAINTENANCE

(Period October 25, 1985 thru December 31, 1985)

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FEED MATERIALS PRODUCTION CENTER

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I. BACKGROUND

The basic purpose of the transition program in the operations area was to obtain a detailed understanding of the FMPC operations with emphasis on equipment and organization. Also considered in this evaluation were several extant conditions at FMPC which may have significant impact on initiatives adopted in the operations area. These conditions are as follows:

- Capital expenditures over the last several years averaged less than 20% of what might be considered minimum to sustain such a facility in a good operating condition.
- The production load is ramping up placing greater demands on an old facility.
- The workforce is relatively inexperienced (68% with less than five (5) years) at FMPC.
- Plans are in place to institute major upgrading of FMPC facilities.
- The RFP described the need for a major effort in the Environment, Safety and Health Area.

Considering the above, the transition program was focused in the following areas:

- Procedures - An inexperienced workforce operating in an atmosphere requiring rigid compliance with more rigorous environmental criteria necessitates clear, concise up-to-date procedures to enhance performance.
- Training - New equipment, new people and rigorous environmental constraints demand an aggressive, focused training program.
- Equipment - Site conditions are not conducive to reliable equipment performance. Specific knowledge of forecasted equipment performance is imperative to control the present and plan the future.
- Restoration - The massive planned expenditures must be well understood to ensure that the future production needs are satisfied and that priorities are aligned with need.
- Maintenance - Based on the site descriptions provided in the RFP, it was clear that the past maintenance practice has been reactive. The facility upgrade program, to be successful, must be complemented by an aggressively managed maintenance program.

The following section describes the results of reviews in these areas of interest. In some cases, the reviews have resulted in recommendations for on-going studies to fulfill our need to understand the present and plan the future. It should also be noted that more specific action plans will be defined during the next month where transition studies have not been completed. These areas include equipment, restoration, and maintenance plans.

II. WORK TASKS

A. EVALUATE OPERATING PROCEDURES

o OBJECTIVE

The objective of this task was to evaluate the procedures used to perform the operations and maintenance functions in the production process at the FMPC to:

- o develop an understanding of the systems used to develop, revise and implement the Standard Operating Procedures (SOP's) and Maintenance Standards.
- o determine the effectiveness of these procedures/systems and identify findings.
- o develop recommendations and corrective actions to improve the effectiveness of these procedures/systems.

o APPROACH

The information required to meet the above objective is presented in the following sections and was developed utilizing the following methods:

- o review of FMPC operating procedure documentation-this included detail reviews of SOP's, Maintenance Standards, Manufacturing Specifications, Production Supply Specifications and the methods used to revise these procedures.
- o on-site observations and tours of the production process, i.e., the Chemical and Metals Plants.
- o consultations with FMPC personnel identified in Attachment A-1.
- o consultations with members of the WMCO Transition Team.
- o review of all of the Quality Assurance audits performed on SOP's and Maintenance Standards in the past year.

It should be noted that initially it was planned to conduct on-site observations of a number of procedures during execution to evaluate the effectiveness of the procedures. However, after reviewing the information provided by the procedure audits and consultations with NLO and WMCO personnel, it was concluded that this effort would not provide any significant information that would be required to complete this task.

1. FINDINGS

- a) There is no overall site procedure to provide instructions on how to prepare production operations and maintenance procedures.
- b) The numbering (identification) system for SOP's, Maintenance Standards, Manufacturing Specifications and Production Supply Specifications is inconsistent and confusing.
- c) The content and utilization of most of the SOP's and Maintenance Standards are inadequate. The specific reasons for this finding are given in Attachment A-2.
- d) The system used to create new procedures or revise procedures is not responsive as required. There is a significant back-log of procedures to be processed for completion and implementation.
- e) All of the SOP's, Manufacturing Specifications and Production Supply Specifications are the responsibility of the QA/QC Department. It is considered that the responsibility for procedures should lie within the department that must use them in order to provide effective procedures and timely revisions.
- f) In general, the production operations and maintenance procedures lack information that would aid the operator. Examples of this type of information include schematics, diagrams, illustrations, equipment numbers and more detailed process descriptions.
- g) The content of most of the Maintenance Standards does not provide adequate procedural information to properly perform the associated maintenance operation. This should be a significant concern especially with the newer (less experienced) personnel.

- h) Not all of the applicable equipment are covered by the Maintenance Standards procedures now being used:
- i) Existing maintenance procedures do not adequately identify the required tools and repair parts necessary to complete the associated maintenance operation.
- j) The maintenance procedures recently developed for changing the bags on the site dust collectors followed the format of the SOP's rather than the format presently used for Maintenance Standards. It is considered that the dust collector procedures are the type of maintenance procedures that should be adopted for future revisions.
- k) Other Findings - There were a number of observations made during this study which were not directly applicable to the subject at hand. These observations or findings are summarized with corresponding recommendations and actions in Attachment A-3.

2. RECOMMENDATIONS

- a) Develop an overall site procedure to provide instructions on how to prepare production operations and maintenance procedures as well as all other site procedures. This procedure would establish the standards for format, detail, terminology, diagrams, illustrations, etc., thus minimizing inconsistencies between site procedures. (Finding 1. a)
- b) Develop a consistent and simple numbering (identification) system for all site procedures. (Finding 1.b)
- c) Establish a Production Procedures Group in Production Operations. It is suggested that this new group have the responsibilities as outlined in Figure A-1 with the initial responsibility to respond to the concerns of Findings 1.c, 1.d, and 1.f. Another early action that the group should be involved in is the participation on the ad hoc committee to develop an overall site procedure as discussed in Corrective Action item 3.a. The group would report directly to the Manager of Operations Training and interface closely with the Operations Training and Administrative Support Groups. Some suggested responsibilities for the

FIGURE A-1 - RECOMMENDED OPERATIONS TRAINING FUNCTIONS AND AREAS OF RESPONSIBILITY

Administrative Support Group are also shown in Figure A-1. (Findings 1.c, 1.d, 1.e and 1.f)

- d) The system used to revise SOP's should incorporate some new methods to expedite revisions and complement the production process. Some suggestions are:

- o Establish criteria for types and classifications of SOP Change Requests.

Examples of this are:

Types: Normal (change can be completed as indicated)

Urgent (change can be completed in a very short time, say two (2) days)

Classification:

- 1 - Maximum signoff required.
Affects production.
Safety system involved
- 2 - Modified signoff required.
Affects production
- 3 - Minimum signoff required.
Minimum impact.
Mostly administrative changes

- o Revise the system to process SOP Change Requests. An example of a system considered to be viable is:

- an Area Supervisor initiates/ prepares a procedure change, then discusses it with his General Supervisor who approves the change.
- at this point, the General Supervisor meets with the appropriate engineer (from the Chemical or Metals Plants) and a member of the Production Procedures Group to determine the technical impact, type and classification of the change.

- Production Procedures then finalizes the SOP Change Request form and marks up a copy of the SOP to be changed.
 - the package is then given to the Administrative Support Group who expedites the approval signoffs as necessary.
 - when all the approval signatures are obtained, Administrative Support and Production Procedures then provide the necessary follow-up to implement the change, with the final step being delivering the revised procedure to the appropriate Production Supervisors.
 - o Establish a Change Control Board under Production Operations to provide prompt reviews and sign-offs of SOP Change Requests. (Finding 1.d)
- e) Establish a Maintenance Procedures Group under the direction of the Maintenance Department Manager. The primary functions of this group should be to review, prepare, revise and maintain the present Maintenance Standards as necessary. Consideration should be given to subcontracting this work to an outside consultant group with future follow by the Production Procedures Group. (Findings 1.g, 1.h and 1.i)
- f) The Maintenance Procedures Group should evaluate the format and detail that should be used for all maintenance procedures and interface this effort with the ad hoc committee requested to develop an overall site procedure discussed in Corrective Action item 3.a. (Finding 1.j)

3. CORRECTIVE ACTIONS

- a) Administrative Services will be requested to establish an ad hoc committee to develop an overall site procedure to provide instructions on how to prepare procedures. Once this overall site procedure is in place, Administrative

Services will maintain and revise the procedure as necessary as part of its function of document control.
(Recommendation 2.a)

- b) Administrative Services will be requested to establish a consistent and simple numbering (identification) system for all site procedures as part of its function of document control.
(Recommendation 2.b)
- c) Vice President and General Manager of Production Operations Group will review and recommend staff structure changes similar to that suggested in Figure A-1.
(Recommendation 2.c)
- d) Manager of Operations Training will develop plan and recommendations to revise the SOP Change Request System.
(Recommendation 2.d)
- e) Maintenance Department will develop the scope, schedule and recommendations for the work required to revise the maintenance procedures.
(Recommendation 2.e and 2.f)

ATTACHMENT A-1

FMPC Personnel Contributing to Task Input

The following FMPC personnel provided information, observations, comments, suggestions, etc. in personal meetings and plant tours that were considered in developing the input to Work Task II. A:

D. A. Tippenhauer, Department Head - QA/QC
N. K. Weichold, Chief Methods Analyst - QA/QC
D. L. Dunaway, Superintendent - Chemical Plants
W. J. Bicha, Engineer - Chemical Plants
S. C. Vaaler, Engineer - Chemical Plants
K. A. Carney, Engineer - Chemical Plants
R. L. Gardner, General Supervisor - Plants 2/3, 8 and Pilot
Plant
D. D. Gilbert, Area Supervisor - Pilot Plant
T. N. Huey, Acting Area Supervisor - Plants 2/3 and 8
H. E. McDaniel, General Supervisor - Plants 1 and 4
W. A. York, Area Supervisor - Plants 1 and 4
G. R. Blank, Superintendent - Metals Plants
J. K. Welborn, Engineer - Metals Plants
E. Schonegg, General Supervisor - Plants 6 and 9
D. C. Bonfer, Senior Staff Engineer - Production Division
L. C. Dolan, Chief - Nuclear Safety
M. V. Carle, Senior Maintenance Engineer - Mechanical
Department

ATTACHMENT A-2
STANDARD OPERATING PROCEDURE AND
MAINTENANCE STANDARD AUDIT AND REVIEW FINDINGS

The following is a list of significant findings that pertain to the content and utilization of SOP's and Maintenance Standards. This list was developed from the review of all of the QA audits performed on SOP's and Maintenance Standards in the past year plus independent, detail reviews of many of the procedures by the WMCO Transition Team.

- 1) SOP's and Maintenance Standards were not available in the immediate area (i.e. work station of the operation).
- 2) Equipment being operated/used not mentioned in SOP.
- 3) Equipment being operated/used not properly identified in SOP.
- 4) Some operations being performed not included in an SOP.
- 5) References to SOP's, Maintenance Standards, Manufacturing Specifications, etc. required to complete the SOP are not included in procedure.
- 6) Current standard statements on Environmental Considerations, Industrial Safety, etc. are not in all the procedures.
- 7) The section of "Industrial Safety Requirements" is not complete for all procedures, e.g., equipment to be worn not included.
- 8) Procedure parameters to be followed/observed/checked not defined or specified in procedure.
- 9) Procedures being used not up to date per latest revisions.
- 10) Procedure operating parameters not being followed.
- 11) Equipment included/discussed in SOP or Maintenance Standard no longer used or in area.
- 12) Rating of equipment (e.g. hoists/cranes) different than in procedure or other information.
- 13) Format not consistent from procedure to procedure.
- 14) Manual mentioned in the standard is for equipment no longer in use.

Attachment A-2 (Continued)

- 15) Material discussed in procedure no longer used in process.
- 16) Procedure title does not adequately describe the operations that are being performed by the procedure.
- 17) Equipment numbers, ID numbers, and nomenclature plates have been painted over and are no longer visible.
- 18) Maintenance Standards do not have a cancellation system.
- 19) All of the information required by the procedure to be documented is not documented.
- 20) Instructions to be followed in case of an accident or abnormal condition are not included in some of the procedures.
- 21) In general, the procedures lack the detail necessary to be used by new operators properly.

ATTACHMENT A-3

OTHER FINDINGS/RECOMMENDATIONS/CORRECTIVE ACTIONS

1. Finding ----- Identification of spare parts requirements to minimize production downtime is not adequate.

Recommendation ----- Maintenance Department should identify spare parts requirements for existing equipment and recommend spare parts levels for maximum and minimum inventories. Spare parts requirements for new equipment should be identified by Project Engineering.

Corrective Action --- Maintenance Department and Project Engineering should provide the scope and recommendations for this effort.
2. Finding ----- Of the spare parts that have been identified and established as stores items, many are not available for the Maintenance Department to perform the required corrective actions to minimize production downtime. Also, the paperwork required to reorder parts is cumbersome and results in delays thus increasing production downtime.

Recommendation ----- The system for inventory control, reordering and purchasing of spare parts should be reviewed for the purpose of streamlining the process to minimize production downtime.

Correction Action --- Administrative Services (Procurement) should provide the scope and recommendations for this effort.
3. Finding ----- Communications between Production (viz, Chemical and Metals Plants) and the Maintenance Department personnel at all levels needs to be improved.

Recommendation ----- The managers of Production and the Maintenance Department should develop the initial plans to improve communications and present recommendations to the Vice President and Manager of Production Operations.

Attachment A-3 (Continued)

Corrective Action --- Vice President and Manager of Production Operations should develop scope and schedule for this effort.

4. Finding ----- There is a need to establish a new group to represent Production Operations in the planning and decision making involved during the upgrading of the overall site facility.

Recommendation ----- Establish the position of Manager of Facilities Integration reporting to the Vice President and Manager of Production Operations. Some suggested responsibilities for this group would be:

- coordinate timely operations reviews of on-going facility projects.
- identify operational needs relative to new or upgraded facilities.
- provide process engineering support to operations during the installation, shakedown and qualification phases of new equipment development.
- develop program reviews.

Corrective Action --- Vice President and Manager of Production Operations will determine feasibility of this action.

5. Finding ----- The production process (Chemical and Metals Plants) is inadequately defined by written documentation, i.e. manuals.

Recommendation ----- Plant manuals that provide detailed descriptions of the production process should be developed. These manuals would provide much needed educational and training tools for the management, engineers and operators.

Corrective Action --- Vice President and Manager of Production Operations should evaluate

Attachment A-3 (Continued)

the feasibility of this effort and establish the scope and schedule.

6. Finding ----- There appears to be a need for more effort devoted to safety engineering in the production process.

Recommendation ----- Establish the position of safety engineer in the Chemical and Metals Plants. Some suggestions for the responsibilities for this position are:

- expedite/coordinate procedure signoff/approval in the safety area
- minor event report follow-up
- incident report review and follow-up
- unusual occurrence report review and follow-up
- job safety analysis
- develop plans to achieve "ALARA" conditions
- write Operational Safety Requirements
- conduct area inspections
- maintain safety documentation

Corrective Action --- Managers of the Chemical and Metals Plants review this recommendation and advise Vice President and Manager of Production Operations of appropriate action.

B. ASSESS UNIT OPERATIONS FOR CAPACITY AND YIELD

○ OBJECTIVE

Determine if present capacities and yields will satisfy projected production requirements and recommend actions to accommodate potential problems.

○ APPROACH

The production of feed material at FMPC involves a series of interconnected chemical and metallurgical operations in which UF_4 of various isotopic compositions is generated by off-site receipts or on-site conversions and then is reduced to U metal. The metal is processed through casting and machining operations and converted to various products to meet customer requirements. The principle production operations at FMPC are summarized schematically in Figure B-1.

To accomplish the objectives of Task B, it was necessary to become familiar with the operations involved, establish the effective capacities and yields for all unit operations, determine current and projected production requirements and then assess whether capacities and yields are adequate to meet these requirements. To assist in this evaluation, a flowsheet indicating major operations and process streams was prepared and is illustrated in Figure B-2 and Table B-1. Important informational sources sought to support this effort were engineering flowsheets and mass balances for the various unit operations including important interfacing waste and feed streams; and records (or projections) of the impact of maintenance, equipment conditions and EH&S requirements on current and future capacities and yields. In summary, the principle activities supporting this Task were as follows:

- Review and assess FMPC capacity and yield information.
- Review and assess existing FMPC process flow and material balance sheets.
- Review and assess capability to meet production load projections for current and subsequent years.
- Review and assess operating and maintenance records relative to impacts on capacity and yield.
- Review and assess impact of EH&S requirements and equipment conditions on process capacity and yield.

Schematic Diagram of the FMPC Process

Figure B-1

TABLE B-1

MATERIAL STREAM FLOWS FOR FIGURE B-2

<u>STREAM</u>	<u>MATERIAL</u>	<u>ISOTOPIC</u>
1	Metal fines, Oxidic Residues, Slag, Sludge	enriched
2	Oxidic Residues	"
3	Non-remeltable metal crops, etc.	"
4	Impure UNH	"
5	Separated UNH (OK Liquor)	"
6	UO ₃	"
7a, 7b	UO ₃ , U ₃ O ₈	"
8	UF ₄	depleted
9	UF ₄	enriched
10	UF ₄	"
11	UF ₄	depleted
12	N-Reactor Derbies	enriched
13	N-Reactor Remelt Metal	"
14	Y12, RF Derbies	depleted
15	RF 4" & 2" Flats, Mark 30 & 25 Derbies	depleted, enriched
16	Mark 30 & 25, RF 4"/2" Remelt Metal	" , "
17	Mark 30 Ingots	"
18	Mark 25 Ingots	enriched
19	RF 4" & 2" Flat Castings	depleted
20	N-Reactor Ingots, Mark 30 & 25 Ingots	depleted, enriched
21	Stream 20 Material (Bored, Champfered, OD)	" , "
22	Mark 30 & 25 Inner & Outer Tubes	" , "
23	Mark 30 & 25 Innater & Outer Cores	" , "

1. FINDINGS

- a) The yield information and data for any given operation or process were not available.
- b) Present effective capacities provided for principal unit operation, (R. M. Spenceley to J. A. Reafsnyder, December 12, 1985) were reviewed and considered to be reasonable for production planning based on our knowledge of the process and equipment.
- c) It was not apparent that historical production control records for capacities and yields for any given process or operation exist. The present effective capacity information is based predominantly on individual experience and background.
- d) It is not apparent that the effective capacity values reflect the condition and reliability of aged processing and support equipment and services.
- e) The capacity values for Plant 2/3 indicated 600 MTU/yr. for normal operation. Presently an abnormal situation exists in which these facilities cannot operate. As a consequence, it may be necessary to procure (make up feed material) and/or build up recycle product inventory. The recycle inventory build up will adversely impact storage area, material recall, accountability, environmental consequences and production operations.
- f) There was no evidence that process flow and materials balance sheets exist for any process or operation. This information is necessary to assist in determining process control, operations, accountability, interfacing feed and waste streams and service requirements.
- g) Production load requirements were reviewed relative to present effective capacity values and are presented in Table B-2. This information indicates a lack of Production capacity for 6-4 processing in 1987 and Plant 5 casting in years 1988, 1989 and 1990. Additionally, 6-4 processing is marginal in 1988, 1989 and 1990; metal reduction (Plant 5) and casting (Plant 9) are also marginal for the years 1987-1990.
- h) Historical production operational processing and maintenance records necessary to estimate the

TABLE B-2.

PROJECTED OPERATIONAL DAYS BY PRODUCTION OPERATION

<u>Operation</u>	<u>Present Effective Capacity, MTU/day</u>	<u>Operational Days Required Per FY (1) (4)</u>					<u>Comments</u>
		<u>86</u>	<u>87</u>	<u>88</u>	<u>89</u>	<u>90</u>	
Scrap Recovery	1.48	236	169	169	169	169	Does not include scrap back-log reduction, marginal '86 on 5 day week
Digestion	11	32	23	23/33	23	23	
Extraction	10	35	25	25/37	25	25	Campaign Operations
Denitration	8	44	32	32/46	32	32	
Total Plant 2/3		111	80	80/116	80	80	--
R-O-R	7.2	151	125	119/119	119	121	--
Hydro Fluorination	10.4	105	111	107/118	106	108	--
Total Plant 4		256	236	226/237	225	229	Exceeds and is marginal on 5 day week.
6-4	5 (FY86)	285	--	--	--	--	Exceeds 5 day week
	12 (FY87)	--	504	--	--	--	Exceeds 7 day week
	24 (FY88-90)	--	--	336	336	336	Marginal on 7 day week
Metal Reduction	22.5	293 (2)	336 (2)	336(2)	336(2)	336(2)	Marginal on 7 day week, does not include purchased derbies.
Casting, Plant 5	24.8	224 (2)	367 (2)	412(2)	403(2)	403 (2)	Exceeds 7 day capacity 87-90.
Casting, Plant 9	5.1	311	326	327	326	326	Marginal on 7 day week, 87-90.
Ingot Machine, Plant 9	28.6	145	166/140	201/297	195	195	

TABLE B-2. (cont'd)

<u>Operation</u>	<u>Present Effective Capacity, MTU/day</u>	<u>Operational Days Required Per FY</u>					<u>Comments</u>
		<u>86</u>	<u>87</u>	<u>88</u>	<u>89</u>	<u>90</u>	
Ingot Heat Treat Plant 9	36	116	132/112	160/236	155	155	--
Core Machine Plant 6	19.8	93	114/93	143/143	143	143	--
Core Heat Treat Plant 6	11.3	163	200/163	251/251	251	251	Marginal on 5 day week for 88-90.

- (1) Where one value appears, base and alternate cases are same.
- (2) Base case only given as it is maximum production requirements.
- (3) R. M. Spenceley to J. A. Reafsnyder, review of FMPC capacities, Dec.12, 1985.
- (4) R. C. Kispert to C. H. Handel, FY 1988 Budget, Dec. 2, 1985 used as data base.

impact of these attributes on the effective capacity values were not available for evaluation.

- i) Capacity and yield information for 2" and 4" flat machining is not included in current production capacity data base.

2. RECOMMENDATIONS

- a) Initiate a study to determine actual unit production operation capacities and yields utilizing input from operating, maintenance and production planning personnel. The output of this study should be a system to obtain, control and retain production records relative to capacity and yield and those factors which impact processing time and production throughput; i.e., maintenance, manpower, environmental, safety, etc. (Findings 1.a, 1.c, 1.d, 1.f and 1.h).
- b) The operation of Plant 2/3 is necessary to recycle enriched scrap and minimize recycle material build up and potential environmental consequences. This operation should be evaluated immediately to ascertain the most expeditious path to provide enriched scrap recycle product to the interfacing production operation. Therefore, it is recommended that:
 - o Initiate a review of the present plan and status to commence operation of Plant 2/3.
 - o A list of alternative methods be prepared and evaluated to accommodate enriched scrap material. Possible alternatives may include; alternative chemical process, outside vendor recovery/conversion, construct new recovery/conversion facilities in the Pilot Plant, etc. (Finding 1.e)
- c) Initiate a study to select the most prudent action to accommodate the perceived production capacity shortfall for 6-4 conversion, metal reduction and casting operations in the years 1987-1990. (Finding 1.g.)
- d) The production capacity for green salt production could be enhanced if offsite UO_3 could be directly reduced and fluorinated without the ROR step. It is recommended that efforts be initiated to assess the offsite UO_3 process and determine if changes can be instituted to alter the physical characteristics of the UO_3 product thus making it more amenable to the FMPC process. (Finding 1.g)

3. CORRECTIVE ACTIONS

- a) Prepare and document detailed process flow diagrams and mass balance sheets for each unit operation. The documents should be controlled and revised on a routine basis to reflect equipment changes and process modifications (Findings 1.a and 1.f).
- b) Include capacity and yield information for 2" and 4" flats in all subsequent production capacity data bases. (Finding 1.i)

C. REVIEW CONDITION OF FMPC SITE AND EQUIPMENT

○ OBJECTIVE

Review site and production equipment to evaluate condition and expected reliability of performance, identify potential equipment reliability problems with respect to meeting production goals and recommend further studies or actions to resolve those problems.

○ APPROACH

Viable production equipment must have effective capacities and yields and an operational reliability sufficiently high to meet production throughputs. Review of capacity and yield characteristics were addressed under work task B. In this section, the operational reliability of equipment associated with principal production and interfacing operations is addressed. For the FMPC, equipment with long calendar and processing histories are the general rule. Therefore, an important aspect in assessing the reliability of existing equipment is to predict the expected future performance reliability based on present condition and operational/maintenance history. To aid this, simplified performance criteria were adopted in order to assign numerical rankings reflecting predictions of expected future performance reliability, i.e. Predicted Performance Reliability Numbers (PPRN). The criteria adopted and corresponding PPRN were as follows:

<u>PPRN</u>	<u>PERFORMANCE CRITERIA</u>
1	Future performance predicted to be highly suspect, deserves immediate attention.
2	Future performance predicted to be marginal, requires additional study.

Numbers were determined for all principal equipment associated with major unit and interfacing production operations. Number assignments were principally based on transition personnel observations, dialogue with on-floor personnel and any documented FMPC equipment status reviews available. Important factors were observed condition of operating equipment, equipment age, production history and maintenance/downtime history when this information was available.

Another factor considered was the impact of "predicted future performance" on production. An important consideration in this respect is whether redundant equipment exists which can be used to perform the specific production operations in the event of shut-down of the primary operating equipment. To assess this for unit operations, Redundant Equipment Numbers (REN) were adopted and quantized according to the following redundancy criteria:

<u>REN</u>	<u>REDUNDANCY CRITERIA</u>
0	No equipment exists to perform identical function
1	Equipment exists to perform identical function

Redundancy number assignments were established principally by on-floor observations and information provided by operating personnel. Rarely was documented information on redundant equipment available. In most cases at FMPC, redundant equipment fell in the category of "idled" or "stand-by", and in some cases, "abandoned"; all, however, redundant equipment was still considered to be capable of performing a given function as performed by the primary equipment.

Finally, utilizing both the PPRN and REN numbers in an additive fashion gives a new performance number, i.e. a Figure of Merit (FM=PPRN+REN) for production performance which reflects both reliability and redundancy. The magnitude of the FM number gives a relatively simple, qualitative measure of the predicted ability of given operational equipment to reliably fulfill production throughputs. Equipment with FM values of 1 and 2 indicates that the ability of that equipment to reliably perform production functions is predicted to be highly questionable and marginal, respectively. Conversely, equipment with an FM of 3 or 4 probably will perform satisfactorily.

1. FINDINGS

- a) A complete review and assessment of all FMPC site operations and equipment was not possible in the time allotted for this effort. Reviews were completed on the equipment associated with most of the principle unit and interfacing production operations of Plants 2, 3, 4, 5, 6 and 9. Reviews were incomplete on equipment in the pilot plant, Plants 1 and 8, tank farm, general sump, hot/cold raffinate area and the balance of site support and service facilities. While the cooperation of individual FMPC personnel contacted was satisfactory, reviews and assessment of equipment, in general, were impeded somewhat due to the complexity of plant operations, complexity of intra-plant interfaces, difficulty in determining current stream flows for unit operations and interfaces, problems in identifying equipment currently in use and the occurrence of a large number of abandoned-in-place, idled and stand-by equipment.
- b) Documented histories of maintenance detailing and summarizing maintenance frequency, downtime and type of repair are valuable pieces of information in the assessment of future performance predictions of "aged" equipment. While fragmented, non-integrated data of this type probably exists at FMPC, documented summaries of general equipment maintenance for the site were not available to transition personnel. In addition, site equipment lists and detailed material stream flows between equipment items both inter-and intra- to unit operations were not available. In this review, most of the maintenance and material stream flow information for a given equipment item was gleaned from personal

observations, dialogue with operating/supervisory/engineering personnel and a few FMPC memoranda generated in support of restoration and/or EH&S packages.

- c) A summary of performance predictions for operations and equipment reviewed by plant is given in Table C.1. In this tabulation, low values (<3) of Figure of Merit (FM) reflect operations or equipment for which performance reliability problems potentially may exist in meeting future production goals. In the subsequent findings given below, observations on the condition of equipment in Table C.1 with FM values of 1 and 2 are given.
- d) Plant 1
 - The storage area and operations appear inadequate. The outlook is that residue, waste and receipt inventory will increase leading to saturation, potential environmental consequences and difficulty in material recall and accountability.
 - In waste oil burning, the low BTU content (water contaminated) lowers the burner throughput resulting in build-up of contaminated waste oil. Existing aging tanks for water separation are not of adequate capacities.
 - The Titan Mill is aged and has a high-to-moderate frequency of maintenance and downtime. The efficiency of dust collection and control is questionable. The mill is not consistent in producing milled slag of required liner quality.
- e) Plant 2/3 (Presently inactive due to Pu problems)
 - The off-gas system of the metal digestors is inadequate resulting in excessive reduction in capacity when operating. Presently, metal crop digestions are conducted in a batch vessel not designed for this purpose.
 - The Safe Geometry Digestion System shows extensive corrosion effects leading to a suspicion of questionable structural integrity.

with FM values of 1 and 2 are given.

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e) Plant 2/3 (Presently inactive due to Pu problems)

- The off-gas system of the metal digestors is inadequate resulting in excessive reduction in capacity when operating. Presently, metal crop digestions are conducted in a batch vessel not designed for this purpose.
- The Safe Geometry Digestion System shows extensive corrosion effects.
- The UO_3 Gulping systems are highly manual and appear to have difficulty in controlling dust.
- The present Acid Recovery and NO_x control system needs to be updated to reduce emission of NO_x to the atmosphere during Plant 2/3 operations. NO_x emissions have resulted in periodic shutdown of Plant 2/3 operations in the past.

f) Plant 4

- There is some uncertainty as to whether "redundant" equipment for ROR or hydrofluorination exists in this Plant. Banks 7, 8 and 9 are presently in use but Banks 10, 11, and 12

(designated as abandoned-in-place) may be available for use. The conversion of RLO/SRO UO_3 to U_3O_8 (R-O) in a single bank imposes a constraint on UF_4 production.

- There is a high frequency of maintenance of the ROR and hydrofluorination furnaces due to heater element replacement and difficulties with seal tank operation and feed control. Also, there is moderate frequency of ribbon of weld failures on the ribbon.
- The dust collection system for the ROR and Hydrofluorination Banks and conveying systems appears to be inadequate based on the observed green salt in proximity of these units.
- The UF_4 packaging systems may need to be updated.

g) Plant 5

- The general materials handling in Plant 5 is characterized by congested areas, utilization of inadequate handling equipment and handling practices.
- Based on the observed green salt around and on the F machines, it appears that the dust control systems and mode of operation need to be improved.
- Capping, lidding and transport in the reduction area is highly manual, congested and with little ventilation control.
- Based on observations made during operations, the capacity of the air and water cooling pools were insufficient to accommodate standard reduction throughputs. This resulted in placing reduction pots on the operational area floors creating a potential safety hazard and extending cooling times. There is no indicated equipment, areas or procedures for handling bottom blow-outs. The ventilation control on reduction pots did not appear adequate for top (flash) blow-outs.

- Operations in the derby break-out area appear to be highly manually intensive and a dusty operation leading to potential safety hazards to personnel.
- There is an insufficient number of vacuum induction furnaces to accomodate both flat and cylindrical casting operations simultaneously. Contingency equipment and controlled areas to handle metal spills are not adequate.
- The present depleted slag recycle system in Bldg. 55 is aged, is mechanically intensive and has a high frequency of maintenance and downtime to maintain suitable slag recycle quality. Excessive downtime periodically causes problems in maintaining the desired liner material inventory in the feed tank in Plant 5.
- In enriched slag recycle, the problem appears to be a materials handling problem in that, due to lack of recycle equipment in Plant 5, this material must be drummed and sent to the Titan Mill in Plant 1. There is quality and quantity of recycled enriched slag for liner use.
- Operations in Plant 5 are dusty. Existing dust collectors have a high frequency of maintenance and there are indications that the present dust systems may be marginal in meeting environmental and ALARA requirements.

h) Plant 6

- The transfermatic facility has a moderate-to-high maintenance frequency due both to periodic repair of the unit machines and a persistent clogging of the interfacing chip and turning transport stream. While there are redundant "stand-by" machines, they perform individual functions which are done "in-totality" by the transfermatic. These stand-by machines have been idled for sometime and may require considerable time to bring to a state capable of meeting production throughputs. It was also noted that in the transfermatic machine any isotopic cross-overs will require extensive downtime and changes in feed (inner vs. outer cores) will require downtime for machine adjustments.

- The briquetting press has a high maintenance frequency due to jamming of briquettes during expulsion and conveyance from the machine, periodic downtime to readjust press-to-feed flow causing undersized and/or deformed briquettes and extensive downtime to clean the machine for isotopic crossovers.
- Observations of the pickling operations indicated that there was no positive control on effluent gases (NO_x) from the baths either to the hood ducting, or the stack. Further, there was no NO_x monitoring on gases expelled to stack or environment. In addition, the receiving and holding areas of pickling is inadequate with respect to capacity; causing congestion and difficulty in transferring materials and presenting potential safety hazards.
- Observations of the NuSal bath during operation indicated no control of gaseous effluents and marginal safeguards against foreign objects entering the bath. Further, operating personnel indicated difficulty in maintaining temperature of the water bath which impacted and delayed quenching of ingots. A disadvantage in the location of this facility is that it necessitates transport of cast ingots from Plant 9.

i) Plant 9

- The vacuum induction furnaces are aged and have a history of frequent maintenance and downtime. Downtime on these furnaces directly adversely impacts production and delivery of N-Reactor ingots to RMI.
- Ingot borers and surface-chamfer lathes should be enclosed and better ventilated. In addition, ingot lathes are aged and have a high maintenance frequency in order to maintain the quality of machining operations.
- Observations of the ZIRNLO process during operation indicated no control of effluent off-gas (dumping directly to a roof stack) and marginal instrumentation and procedural control of the process.

j) Pilot Plant (6-4)

- Refrigeration unit for anhyrous HF condensation and recovery is inadequate to handle effluent from the 6-4 reactors at full capacity. Packaging systems design include provisions for enclosed capping of drums; but, in actual operations observed, capping was done manually.

k) General Observation

- During the course of the review, it was evident that the FMPC site represents an "old" design that has essentially remained unmodified to meet modern feed material production objectives. This has resulted in a complexity of in-plant operations and intra-plant transfers; and a preponderance of "abandoned-in-place" or "idled" equipment resulting in plant areas not being used productively. The site appears ripe for consolidation of some plants and/or operations, for example, chemical operations in Plants 2, 3, 4, 8 and 6-4.

2. RECOMMENDATIONS

- a) Since an on-site review of all site equipment (support, service and production) was definitely impeded by lack of current detailed information, it is recommended that a study be initiated with the objectives of documenting 1) up-to-date equipment lists, 2) material balance sheets (including interfacing equipment) for streams involved with equipment items and 3) summaries of maintenance frequency and downtime for each. Control and revision of this documentation on periodic basis will permit update of equipment condition and permit more accurate predictions of capacities/yields and equipment reliability with respect to production planning (Finding 1a, 1b).
- b) It is recommended that a study be performed on all equipment items in Table C.1 with FM values of 1 and 2 with the goal of establishing reasons for conditional inadequacies observed and recommending further

i) Plant 9

- The vacuum induction furnaces are aged and have a history of frequent maintenance and downtime. Downtime on these furnaces directly adversely impacts production and delivery of N-Reactor ingots to RMI.
- Ingot borers and surface-chamfer lathes are not enclosed or adequately ventilated posing safety hazards to personnel and difficulty in meeting environmental and ALARA requirements. In addition, ingot lathes are aged and have a high maintenance frequency in order to maintain the quality of machining operations.
- Observations of the ZIRNLO process during operation indicated no control of effluent off-gas (dumping directly to a roof stack) and marginal instrumentation and procedural control of the process.

j) Pilot Plant (6-4)

- Refrigeration unit for anhydrous HF condensation and recovery is inadequate to handle effluent from the 6-4 reactors at full capacity. Packaging systems design include provisions for enclosed capping of drums; but, in actual operations observed, capping was done manually. This poses the potential problem of both salt as well as personnel contamination.

k) General Observation

- During the course of the review, it was evident that the FMPC site represents an "old" design that has essentially remained unmodified to meet modern feed material production objectives. This has resulted in a complexity of in-plant operations and intra-plant transfers; and a preponderance of "abandoned-in-place" or "idled" equipment resulting in plant areas not being used productively. The site appears ripe for consolidation of some plants and/or operations, for example, chemical operations in Plants 2, 3, 4, 8 and 6-4.

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- b) It is recommended that a study be performed on all equipment items in Table C.1 with FM values of 1 and 2 with the goal of establishing reasons for conditional inadequacies observed and recommending further studies or corrective actions to resolve them (Findings 1c thru 1j).
- c) It is recommended that this work effort continue, and those items identified as needing immediate attention be compared with the capital projects to determine all the perceived critical items are being addressed (Findings 1c thru 1j).
- d) Considering the condition of some processing equipment, material logistics, materials handling problems and facilities area utilization, it is recommended that a study be initiated to consider processing consolidation into a single plant; i.e. combine Plants 2/3, 4 and 8 (Finding 1k).

D. ASSESS UNIT OPERATIONS TO PRIORITIZE ES&H CORRECTIVE ACTIONS (This section is combined with E. below.)

E. REVIEW RESTORATION PLANS AND REPRIORITIZE TO OPTIMIZE LOAD RAMP ATTAINMENT

o OBJECTIVE

Evaluate the restoration plan, GPP and ES&H construction projects and assess the integrated impact on the capability to achieve projected

production load and recommend actions to resolve potential problem areas.

○ APPROACH

Restoration as perceived for this assessment included an integration of all capital programs which may impact production operation during the construction phase. The programs considered include: Production and Radiological Improvement (PRI-Package I); Productivity Retention Program (PRP-Packages II, III, IV), General Plant Projects (GPP), and Environmental, Health and Safety programs. The ES&H programs are interwoven with the other programs; therefore, Task D and E are combined into a single report.

To identify and integrate these various programs, it was necessary to interface with Engineering, Production Planning, Operation and ES&H personnel. This resulted in a listing and schedule for each program and the annual production load by plant. It became evident that each program and project within a program had a different action status; i.e., PRI-Package I and PRP-Packages II are approved and funded, as are some GPP's. However, PRP-Packages III and IV are not approved, although projects have been identified by title but a schedule is not available. These various projects were itemized by plant and where available, the construction schedules are indicated (Figures E-1 through E-10.) The balance of unapproved/unscheduled projects peculiar to a specific plant are also listed on the plant project schedule sheet. In addition, the annual production load determined in Task B for each plant is indicated on the schedule. The project construction schedule for each plant must be evaluated relative to the extent of downtime for the specific operations and interfacing services and operations to determine the impact on production throughput. This analysis must be accomplished with cognizant Engineering, Production, and ES&H personnel. This effort will lead to a prioritization and action items to accommodate the production load. Unfortunately, the time available did not permit this final analysis.

1. FINDINGS

a) General

- Obtaining capital project information and schedule impacts for each of the production plants was very time consuming. There appears to be no single source document that contains all the projects and schedules peculiar to a given plant.

Figure E-1

[illegible]

DEPARTMENT
SCHEDULE

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DECEMBER 31, 1985

PROJECT ENGINEER

Figure E-2

CONSTRUCTION

PI

CODE		PROJECT NAME & NO.		1986											
A001	SLAG LEACH PRPI	00-85501													
A002	STACK MONITOR PRPI	00-85501													
A003	METAL DISSOLVER PKGI	00-85501													
B001	REFINERY SUMP PRPII	00-86501													
C001	EXTRACT PROCESS PRPIII	00-87501													
C002	DIGESTER FEED PKGIII	00-87501													
C003	ENR DIGESTION PRPIII	00-87501													
<u>Z000 APPROVAL PENDING</u>															
Z001	DC G1-856	87502													
Z002	CONTROL PAD	87502													
Z003	BLDG VENT IMPV	87502													
Z999	SCHEDULED PRODUCTION	MTU/yr./*													
														350/111

CONSTRUCTION
 PROCUREMENT

*PRODUCTION PROCESSING DAYS

ERING DEPARTMENT

ION SCHEDULE

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ANT 2

DECEMBER 31, 1985

PROJECT EN

Figure E-3

CONSTR

CODE		PROJECT NAME & NO.		1986											
0001	NEW BLOWER NAR SYS	03-84201													
A004	UO3 GULPING PRPI	00-85501													
C004	HN03 RECOVERY PKGIII	00-87501													
<u>Z000 APPROVAL PENDING</u>															
Z004	DC GS-104	87502													
Z005	CONTROL STORE PADS	87502													
Z006	BLDG VENT IMPV	87502													
Z999	SCHEDULED PRODUCTION	MTU/yr./*													

350/111

-CONSTRUCTION -PROCUREMENT

*PRODUCTION PROCESSING DAYS

ENGINEERING DEPARTMENT

CONSTRUCTION SCHEDULE

JLM:KMW

PLANT 3

DECEMBER 31, 1985

PROJECT EN

Figure E-4

CONST

CODE	PROJECT NAME & NUMBER	1986											
		J	F	M	A	M	J	J	A	S	O	N	
0002	HOPPER TURNING DEVICE 04-85201												
0003	PARTIAL RPLC HF PIPE 04-85306												
0004	REACTOR VENTILATION 04-85202												
0005	DUST COLLECTOR RPLC 04-85203												
A005	HF OFFGAS PRPI 00-85501												
B002	N2H2 SYS PRPII 00-86501												
B003	ELEVATORS PRPII 00-86501												
B004	ELEVATORS PRPII 00-86501												
C005	UF4 PACK STAT PRPIII 00-87501												
C006	CRANE PRPIII 00-87501												
<u>U000 OPEN PROJECTS</u>													
U001	UPGRADE HF OFFGAS 85501												
<u>W000 CANCELLED PROJECTS</u>													
W001	REDESIGN FLUID BED HEAT 85501												
<u>X000 PROJECTS ON HOLD</u>													
X002	UPGRADE WEST ANNEX 04-85101												
<u>Y000 COMPLETED PROJECTS</u>													
Y007	UPGRADE LIGHTING 04-84801												
Z999	SCHEDULED PRODUCTION												
	MTU/yr./*												

1087/253

-CONSTRUCTION -PROCUREMENT

*PRODUCTION PROCESSING DAYS

INEERING DEPARTMENT

CONSTRUCTION SCHEDULE

JLM:KMW

PLANT 4

1987												1988												1989												1990											
J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
1149/234												1104/225												1099/224												1119/227											

DECEMBER 31, 1985

Figure E-5

PROJECT ENGINEERING
CONSTRUCTION S
PLANT 5

CODE	PROJECT NAME & NO.	83	1984												1985																
		N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A
0006	BAR CODE EQUIP	05-84201																													
0007	COLD SAW	05-83203																													
0008	BAND SAW	05-83204																													
0009	RPL PLASMA SPRAY UNIT	05-83202																													
0010	INGOT SURFACE CLEAN	05-82101																													
0011	INGOT COOL BOOTH	05-84202																													
0012	RPL DC G5-251	05-85203																													
0013	RPL DC G5-253	05-85204																													
A006	F MACHINE PRPI	00-85501																													
B005	ENRICHED MILL PRPII	00-86501																													
B006	DERBY BREAKOUT PRPII	00-86501																													
B007	MAT HANDLING PRPII	00-86501																													
C007	METAL SPILL PRPIII	00-87501																													
C008	DEPLETED SLAG MILL	00-87501																													
D001	SPECIAL MATL PROCESS	05-83501																													
D002	RPL G5-258 & G5-259	05-83501																													
U000	OPEN PROJECTS																														
U002	EXPAND REDUC FAC	85901																													
U003	WAREHOUSE EXPANSION	85101																													
U004	RPLC DC SLAG MILL	85202																													
U005	CONTROL PAD NORTH/EAST																														
U006	ROCKWELL FCE VENT																														
U007	MOD MELT/CAST FCE																														
V000	REDEFINING SCOPE																														
V001	VENT SYSTEM	85901																													
V002	MOLD DRYING OVEN	85901																													
V003	MATL HANDLE EQUIP	85901																													
V004	MOLD COATING BOOTH	85901																													
V005	HANDLING EQUIPMENT																														
V006	OTHER FACILITIES																														
X000	PROJECTS ON HOLD																														
X003	MOLD OUTGAS FAC	85205																													
Z000	APPROVAL PENDING																														
Z012	BLDG VENT IMPV	87502																													
Z013	DC G5A-100	87502																													
Z014	DC G5-247	87502																													
Z015	DC G5-248	87502																													
Z016	DC G5-262	87502																													
Z017	STORE BLDG	87502																													
Z018	ENCLOSE SAWS LATHES	87502																													
Z019	FCE SYSTEM																														
Z020	AIR FILTRATION																														
Z021	MAINT SHOP EXPAN	85101																													
Z022	FINISHED PROD WAREHOUSE																														
Z999	SCHEDULED PRODUCTION	MTU/yr./*	Derby-Casting																												

6590/25

CONSTRUCTIONPROCUREMENT

6590/24

CONSTRUCTION

PROCUREMENT

*PRODUCTION PROCESSING DAYS

41

JLM:KMM

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DECEMBER 31, 1985

PROJECT ENGINEERING

Figure E-6

CONSTRUCTION

PLANT

CODE	PROJECT NAME & NO.	1986												1987			
		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A
0014	UPGRADE STEAM 06-85101																
A007	PLT6 SUMP PRPI 00-85501																
B008	NOX SCRUBBERS PRPII 00-86501																
<u>V000 REDEFINING SCOPE</u>																	
V007	INGOT SAW MACH 85901																
V008	INGOT SCALP MACH 85901																
V009	INSPEC FAC 85901																
<u>W000 CANCELLED PROJECTS</u>																	
W002	EXTRUSION PRESS 87501																
<u>X000 PROJECTS ON HOLD</u>																	
X004	TRANSFER MACH 86201																
<u>Z000 APPROVAL PENDING</u>																	
Z023	FINISHED PROD WAREHOUSE 85902																
Z024	BLDG VENT IMPV 87502																
Z025	DC G6-6057 87502																
Z026	DC ESP N/MID/S 87502																
Z027	STORAGE U METAL 87502																
Z028	CONT DRUM STORAGE PAD 87502																
Z999	SCHEDULED PRODUCTION																
		MTU/yr./MACH/H.T.* 1840/93/163												2257

-CONSTRUCTION
-PROCUREMENT

*PRODUCTION PROCESSING DAYS
MACH---CORE MACHINING
H.T.---CORE HEAT TREATING

DEPARTMENT

SCHEDULE

JLM:KMW

37					1988					1989					1990													
J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N
																				</								

DECEMBER 31, 1985

PROJECT ENGINEER

Figure E-7

CONSTRUCTION

PLAN

CODE	PROJECT NAME & NO.	1986															
		D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
0015	CAUSTIC UNLOAD LINE 08-85202	▨															
0029	DUST SUP PRIME CALC 08-85306	▨	▨														
A008	DRUM RECOND PRPI 00-85501															▨	
A009	BOX FURNACE PRPI 00-85501												▨	▨	▨	▨	
A010	OXIDATION FURN PRPI 00-85501											▨	▨	▨	▨	▨	
A011	ROTARY KILN PRPI 00-85501																▨
B009	DECLADDING PROC PRPII 00-86501																
B010	PLT8 SUMP PRPII 00-86501																
B011	BOX FURNACE PRPII 00-86501																
C009	OXIDATION FCE PRPIII 00-87501																
C010	CRUSHER SYSTEM PRPIII 00-87501																
<u>Y000 COMPLETED PROJECTS</u>																	
Y008	ABANDONED EQUIP																
Y009	ABANDONED EQUIP																
<u>Z000 APPROVAL PENDING</u>																	
Z030	BLDG VENT IMPV 87502																
Z031	DC G8-035 87502																
Z032	DC G43-27 87502																
Z033	DC G43-29 87502																
Z034	DC G8-021 87502																
Z035	DC G8-024 87502																
Z036	DC G8-057 87502																
Z037	CONTROL STORAGE PAD 87502																
Z038	THORIUM REMOVAL																
Z039	VENT MOD OXID FCE																
Z040	TANKS																
Z999	SCHEDULED PRODUCTION																
		MTU/yr./*												280/190			
		▨-CONSTRUCTION ▨-PROCUREMENT															

*PRODUCTION PROCESSING DAYS

JLM:1

8

1987												1988												1989												1990																																											
A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S																																						
200/136																				200/136																				200/136																				200/136																			

DECEMBER 31, 1985

PROJECT ENGINEERING

Figure E-8

CONSTRUCTION

PLANT

CODE	PROJECT NAME & NO.	1986												1987		
		J	M	A	M	J	J	A	S	O	N	D	J	M	A	M
0016	INGOT LATHE 09-83203															
0017	DEEP HOLE DRILLING 09-83202															
B012	FURNACE 93 PRPII 00-86501															
C011	NUSAL FURNACE PRPIII 00-87501															
<u>X000 PROJECTS ON HOLD</u>																
X006	MULTICAST REMELT FCE 85201															
<u>Z000 APPROVAL PENDING</u>																
Z041	BLDG VENT IMPV 87502															
Z042	DC G42-615 87502															
Z043	CONTROL STORE PAD 87502															
Z044	ENCLOSE SAWS/LATHES 87502															
Z045	RPLC AIR FILT SYS 85202															
Z046	DERBY SALT CLEAN 85203															
Z047	NOX DESTRUCTION 87502															
Z999	SCHEDULED PRODUCTION															
												CAST 4123/195-1662/326			6521/2

CONSTRUCTION
PROCUREMENT

*PRODUCTION PROCESSING DAYS

44

SCHEDULE

JLM:KMY

87					1988					1989					1990												
J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	M	A	M	J	J	A	S	O	N

DECEMBER 31, 1985

PROJECT ENGINEER

Figure E-9

CONSTRUCTION

PLANTS 38,

CODE	PROJECT NAME & NO.	1986											
0019	AUTO PROPANE VALVE	38-85301											
A019	PRODUCTION OUTPUT	(MTU/YR)											
0020	LLWP & SHIPPING	40-86701											
0021	WATER PLT SLUDGE	40-84101											
0022	INTERIM LLWPS	40-85701											
A022	PRODUCTION OUTPUT	(MTU/YR)											
<u>X024 PROJECTS ON HOLD</u>													
X025	CONTAM WASTE INCIN	40-88701											
0023	33 TON CRANE	47-85701											
A023	PRODUCTION OUTPUT	(MTU/YR)

PROCUREMENT CONSTRUCTION

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SCHEDULE

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1987	1988	1989	1990

DECEMBER 31, 1985

PROJECT ENGINEER

Figure E-10

CONSTRUCTION

PLANTS 51, 53,

CODE	PROJECT NAME & NO.	1985												1986																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						

CONSTRUCTION PROCUREMENT

NG DEPARTMENT

SCHEDULE

JLM:KM.

55, AND 74

[illegible]

- A master schedule is available which lists the approved and funded projects identifiable to specific plants. However, the schedule is deficient in not including projects which are approved and funded but are on hold or other disposition. As a result, an accurate assessment of the project impact for a specific plant cannot be obtained from the schedule.
- The planning process and preparation of conceptual design reports for funding approval should contain the projects and an accompanying schedule to justify project cost and duration. This information does not appear to exist for unapproved projects. Therefore, an estimate of the impacts of unscheduled projects on production cannot be determined.
- There appears to be a favorable dialogue between Production Operations personnel and Engineering but not the same freedom of exchange between Production Planning and Engineering personnel. For meaningful discussions to occur within these disciplines, it is necessary to have the benefit and knowledge of all project (funded and unfunded) schedules for a particular plant. This information will permit the determination of near-term and long-term optimum paths required to minimize production downtime and engineering/construction costs. Furthermore, without this type of scheduling and knowledge, it is impossible for Production Planning to develop production schedules that are meaningful to FMPC and the customer.

b) Plants 2/3

- Observation of the capacity and production rates through Plants 2/3 indicate that sufficient production capacity exists to accommodate downtime for construction. However, two (2) basic impacts should be considered before dismissing this issue:
 - 1) Plants 2/3 is currently inoperable and will remain inoperable until the Pu issue is resolved. In the meantime, a backlog of scrap recycle material is accumulating which will impose a greater production load than presently scheduled.

- 2) As noted on the construction schedules (Figure E-2,3), there are unapproved/unscheduled dust collector and building ventilation improvements slated for FY-87 funding. Will the construction of these projects cause a plant shutdown and for what duration? Additionally, if Plants 2/3 are not operable, then enriched feed stock must be procured thus impacting the overall economics of the process and product.

c) Plant 4 (Figure E-4)

- Production scheduled through Plant 4 is about the normal production rate for five-day operation. Some downtime for construction can be accommodated and lost production made up by either preproducing and/or postproducing on a seven-day basis.
- The total impact on production of the indicated construction projects is indeterminant without the assistance of Engineering and Production Operations personnel. However, it is evident that some production downtime will be required and must be defined to assure adequate product flow to subsequent operations.

d) Plant 5 (Figure E-5)

- Plant 5 is extremely vulnerable to production loss due to construction. Presently, this plant is operating on a seven-day-per-week basis to satisfy production requirements, and this load continues through 1990. As a result, any downtime resulting from construction will translate into a production loss with no apparent make-up capacity.
- In addition to the scheduled projects, there are several which are funded and being redefined in scope and schedule; one funded project on hold; several open projects which are indicated in the FY-85 funding base; and several which are slated for FY-87 funding and involve dust collector and building ventilation improvement. The impact of these additional programs can only worsen an existing critical situation.

e) Plant 6 (Figure E-6)

- Plant 6 is extremely vulnerable to production loss due to construction. Presently, this plant is operating on about a five-day production basis; however, in 1987 and beyond, the production load will challenge a seven-day-per-week operation. It is during this period that construction will be

occurring and possible loss of production experienced.

- In addition, there are building ventilation improvements and dust collector systems slated for FY-87 funding which may also adversely impact production throughput.

f) Plant 8 (Figure E-7)

- Production through Plant 8 is sufficiently low to accommodate downtime for construction; however, each project should be evaluated independently and collectively to assure no conflicts arise.

g) Plant 9 (Figure E-8)

- Plant 9 casting capacity is about at the production limit on a seven-day-per-week basis from 1986 through 1990. Construction projects could have an adverse impact on production throughput, especially with the FY-87 funding of construction for building ventilation improvements and dust collector systems.

2. RECOMMENDATION

- a) It is recommended that this evaluation continue and be expanded to a full-time study group with a dedicated representative from Engineering, Production Planning, Production Operations, Environmental Health and Safety and Construction (Rust Engineering).
- b) This study should have as a minimum the following objectives which will result in corrective actions for the itemized findings:
 - Establish a system to maintain documented control of all projects, schedules, and status by plant regardless of funding or approval status.
 - Determine construction impacts on production and optimize construction and production schedule to minimize production downtime.
 - Identify and evaluate options to satisfy production requirements resulting from production shortfalls.
- c) Retain study team to review on a periodic basis the status of production/projects.

F. DEVELOP INTEGRATED MANAGEMENT CONTROL PLAN (Covered Under Section H, Volume 9)

G. EVALUATE QUALIFICATIONS AND TRAINING REQUIREMENTS AND DEVELOP PLAN FOR IMPLEMENTING TRAINING

o OBJECTIVE

Evaluate the training plans at FMPC and develop a plan for implementing a structured training program.

o APPROACH

The existing training plan developed by FMPC was reviewed with the plant Training Supervisor. Features of the plan were discussed to understand the intent and direction of the program. The Plant Superintendents (Metals and Chemical Plants) were interviewed to determine their attitudes toward improved training and to determine what had been accomplished to date.

1. FINDINGS

- a) The training plan as developed to date contains all the key features required to properly train.
- b) Implementation of the plan has been spotty. Most of the accomplishments to date have been the planning aspects. Little actual training has been accomplished.
- c) The focus on training has been somewhat blurred because of the organization being in Human Resources. There's a tendency to think of the program as "their" program, rather than "our" program.
- d) The role of the training department has been one of coordinator rather than being actually responsible for training. Each line manager has been requested to superimpose training on everything else he has to do.
- e) FMPC was pursuing accomplishment of a Job Task Analysis (JTA) as a means of further defining the training needs. The JTA will be performed by a subcontractor and will be completed before the end of FY-86.

2. RECOMMENDATIONS

- a) A revised training plan should be prepared which establishes milestones and responsibilities for completion. Although the plan now identifies steps to be taken, firm dates and commitments for completion have not been established.
(Findings 1a and 1b)

- b) A shift in emphasis from planning to execution is appropriate. No training program can be successful unless some active training is taking place. (Findings 1b and 1d)
- c) All technical training should be under the direct control of a manager experienced in operations, maintenance and training. Leaving technical training to professional trainers with non-technical backgrounds usually leads to a program that cosmetically looks very good but substantively is shallow. Expecting a matrix type organization to produce dramatic results in a short period of time will not work. (Findings 1c and 1d)
- d) The Job Task Analysis (JTA) being pursued should proceed as presently planned. Some shift in emphasis is needed, however, to start developing training curricula before the JTA is complete and starting active training efforts well before the JTA is finished. In this way, the concept of formalized training can be started and instructors can be trained and evaluated as they instruct. Once the JTA is completed, the results can then be factored into existing, ongoing programs to improve them and make them more viable. (Findings 1b and 1e)

3. CORRECTIVE ACTIONS

- a) Prepare a revised training plan with milestones and commitments for establishing each facet of the training by March 31, 1986.
- b) Establish a schedule for continuing training in all plants by February 15, 1986.
- c) Commence regular training to the published schedule by March 1, 1986.
- d) Assign responsibility and allocate resources to the Manager, Operations Training for all technical training by February 1, 1986.
- e) Commence the JTA by PRESEARCH by February 15, 1986.
- f) Complete the JTA by September 1, 1986.
- g) Prepare a plan for modifying ongoing training based on JTA results by September 15, 1986.

NOTE: The responsibility for all of the above is
A. J. Macaulay, Manager, Operations Training.

H. PLAN PREVENTIVE MAINTENANCE PROGRAM (This section is combined with I. below.)

I. ASSESS MAINTENANCE PROGRAM

○ BACKGROUND

The Fernald facility has, since 1977, been in the process of instituting a maintenance program using the Maintenance Manager's Guide, ERHQ-0004 dated 12/76 as a guide. The Guide is not directive in nature but identifies elements which should be considered. In order to comply with the Guide, Fernald considered that computerization of maintenance data would be necessary, and subsequently, purchased a computer program in 1982 at a cost of \$90,000.

Westinghouse has performed an evaluation of the existing program. The findings, recommendations and short and long term corrective actions resulting from the evaluation follow.

○ OBJECTIVE

The objective is to provide a report which identifies detailed recommendations to correct deficiencies discovered during a review of the present program and future planned tasks.

○ APPROACH

Interviews were conducted with key personnel in the maintenance department and maintenance control group. An in-depth review of the present plans and future plans was conducted by reviewing long and short range planning documents. The present software program was reviewed against planned objectives for development of a PM program. All pertinent DOE documents and correspondence relating to the program development were also reviewed. The findings are a summary of the results of the interviews and document reviews.

1. FINDINGS

a) Computer Software

- Originally purchased for \$90,000
- Not being used since up to \$120,000 in modifications to maintenance module is required (up to four (4) month's time)
- Does not include any maintenance analysis modules (present planning is to write analysis programs in-house)

- Includes stores and purchasing modules
- Stores module recently modified for \$60,000
- There is no testing of modifications scheduled (no formal program identified)

b) Computer Hardware

- Presently using old and unreliable Honeywell Model H-200 computer for maintenance
- Two (2) Hewlett-Packard HP-3000 series 3 computers have been installed
- Recommendations have been made to replace the slower series 3 computers with 1 series 68 or Spectrum computer

c) Maintenance Program Development

- There are no procedures which define how the preventive maintenance program is developed
- Present thrust is to computerize corrective and emergency maintenance data, not plan preventive maintenance
- Higher priority is given to stores and purchasing
- There appears to be no formal Preventive Maintenance Development Program planned or in place
- There appears to be a lack of management commitment to development of a PM program

d) Project Personnel/Organization

- Personnel with proper qualifications for PM program development are not assigned to the project
- Personnel assigned do not spend full time on the project
- There are only three (3) persons assigned to the project
- There is no formal organizational chart that ties in concerned departments such as production, quality control, planning, projects, etc.

- The Maintenance Management Control Group has control of the project but comes under the QA/QC department
- The common management tie between the Control Group and Maintenance Department is at the assistant plant manager's level

e) Project Schedule

- Target date for implementation of the present maintenance program is December, 1986.

2. RECOMMENDATIONS

a) Computer Software

- Discontinue use of the present maintenance module of the installed software since:
 - It is not useable in its present condition and requires modifications which have significant impact on price and PM program development schedule
 - It does not include analysis capabilities which are necessary to achieve an effective and efficient maintenance program. There is significant manpower effort to develop these capabilities.
- Install a more comprehensive program, e.g., the Westinghouse Managed Maintenance Program Computer Program (MMCP), since:
 - It is specifically designed to record and analyze PM and CM data
 - Includes analysis modules developed from empirical data
 - The program and analysis modules have been completely tested in-house and in the field in over five (5) years of use
 - Runs on HP-3000 equipment
 - It contains all of the modules and features identified in Attachment H-1

b) Computer Hardware

- Replace the two (2) Hewlett-Packard HP-3000 series 3 computers with a HP Spectrum computer since:
 - It is approximately nine (9) times faster than the series 3 computer. Maintenance will impose a heavy load on the system and the extra speed will maintain efficiency.
 - Other departments will want to computerize their data, thereby imposing even greater loads on the computer.

It is not essential that a new computer be installed prior to commencement of the PM program development. Data can be input to the present system and electronically transferred at a later date.

- It is recommended that the following hardware be purchased to satisfy program needs:

To run the PM program development project:

- 2 computer terminals hardwired to the computer
- 1 300 line/minute printer w/stand
- 2 desktop printers for the terminals

To run the PM program after implementation:

- All of the above plus -
- 5 computer terminals hardwired to the computer
- 1 300 line/minute printer w/stand

c) Maintenance Program Development

- Implement a PM development program as identified in Attachment H-1
- Assign top priority to the PM development program
- Do not compromise the program with priorities established by stores or purchasing

- Provide meaningful management support to the program

d) Project Personnel/Organization

- Implement the organization as identified in Figure H-1 "Recommended Organizational Chart for PM Development Program"
 - The lead engineer and technician #1 would be retained after the project is complete (all data gathering and computer entry)
 - The maintenance engineers, clerks, and one (1) technician should be hired as outside contractors or borrowed from WMCO personnel

e) Project Schedule \

- A new target date for PM program implementation should be identified based on:
 - The number and types of equipment to be considered for inclusion in the PM program
 - The date when qualified persons are cleared and brought on-board
 - The date when hardware necessary to run the project is delivered

3. CORRECTIVE ACTIONS

a) Short Term

- Appropriate personnel should witness a demonstration of the Westinghouse Managed Maintenance Computer Program by the end of January, 1986
- Procure necessary software and hardware by March, 1986
- Hire/transfer necessary personnel by August, 1986
- Train personnel by mid-August, 1986
- Begin Phase I Mobilization as identified in Attachment H-1 by September, 1986

Recommended Organizational Chart for PM Development Program

Figure H-1

b) Long Term

- Continue program development with Phases II through VI as identified in Attachment H-1
- Adjust target completion date for PM program implementation by December, 1986

4. SUMMARY

Adaption of the recommendations in this report will result in compliance with the Maintenance Manager's Guide, ERHQ-0004 dated 12/76. The project structure, as identified in Attachment H-1, which defines how a PM program is developed and the recommended software program to run the project contain all the necessary features to comply with the Manager's Guide for effectively employing a preventive maintenance system.

The cost for implementation of the recommendations will be less than continuing with the present system and result in a complete PM program within 1.5 to 2 years from project inception.

Apparently, there is no organized preventive maintenance development program being instituted at this facility. Rather, work is progressing toward a computerized system for corrective and emergency maintenance data recording for cost tracking and report issuance. Even though this type of history is kept, very little maintenance type history is kept on individual components. Since the present software has no analytical capabilities, this kind of data would be of no use. Analyzing equipment failure history, manpower and hardware expenditures, etc. is important to improve future maintenance efficiency and effectiveness.

Further, the lack of an organized preventive maintenance program affects equipment operation and life. This causes sporadic equipment shut downs that adversely affect production operations. The price paid for an effective preventive maintenance program is quickly recovered through increased equipment reliability and lowered maintenance costs.

A rough estimate for implementation of a 2-year preventive maintenance development program per the recommendations is 10% of one year's total maintenance expenditures. The program can be into full implementation within 1.5 to 2 years from initiation of the project. Partial initiation can

be accomplished on a plant by plant or system by system basis while the project is underway.

The recommendations identified in this report are based on the findings and the writer's over five (5) years experience in the preventive maintenance program field.

Attachment H-1

FEED MATERIALS PRODUCTION CENTER; FERNALD, OHIO PREVENTIVE MAINTENANCE PROGRAM DEVELOPMENT PROJECT

INTRODUCTION

A major goal of any preventive maintenance (PM) program is to reduce operating costs by keeping equipment in good operating condition to avoid failures. PM can prevent untimely failures and can sense when a failure is about to occur. A proper balance between PM and corrective maintenance (CM) must be maintained to achieve maximum equipment availability. A good PM program is the heart of effective maintenance.

The foundation of such a program is the creation of an engineered data base that identifies systems and components, and delineates the actual preventive maintenance activities that should be performed on each component. Basically, this information can be divided into three categories: equipment nameplate data, equipment tag data, and maintenance activity data.

It is then necessary to have sufficient computer capability to effectively and efficiently manipulate the data. This should allow for planning and scheduling; data base refinement by incorporating ongoing experience, vendor recommendations, regulatory changes, etc.; prioritization; maintenance backlog analysis; and manpower and spare parts forecasting analysis.

Once this is accomplished, the next step will be to identify and select component candidates that should be included in the program. As components are selected, nameplate type data, taken from drawings and manuals, should be recorded and entered into the database. It should be noted here, that for this selection process, and for all other steps to follow, work should be conducted on a system by system basis using the data base as a working tool. An engineer should be assigned cognizance for one or more of these systems. Although the cognizant engineer may from time to time require assistance from the other engineers on the project (one system may, for example, require expertise in the mechanical, electrical, I&C and operations areas), he will have the main responsibility for all components in that system. Experience has shown that the continuity gained by this approach eliminates significant redundancy of effort, and greatly reduces potential errors of omission.

Once the components of a particular system are selected, the cognizant engineer for that system will direct the assembling of the preventive maintenance activities for each component. This information will be gleaned from the existing PM program,

technical manuals and bulletins, drawings, and other related documents. In addition, operational and environmental service conditions should be considered to determine their impact on preventive maintenance. Once the information on the individual PM activities for a component is complete, all the activities for that component should be reviewed together in order to eliminate redundancy and to insure an operationally practical PM program for the component. At this step, engineering judgment, maintenance philosophy and possible vendor recommendations are weighed to make the final determination.

When the PM activities for a particular component are finalized, the PM data is also entered into the data base. Once all of the component PM for a system is entered, that system should undergo a preliminary review. When resolution of all comments generated from this review has been made, a formal system review should be conducted jointly by maintenance, and other cognizant production, personnel. After comments from this review have been resolved, the PM for the system will be considered complete and ready for implementation.

What follows is a flow chart for a PM program development effort and detailed descriptions for each element on the flow chart.

Attachment H-1 (Continued)

PHASE I - MOBILIZATION

A. Establish A Preventive Maintenance Computer Program

Once the need for a preventive maintenance program has been established, the next logical step is to computerize it to make it run as efficiently as possible. Choosing the right program and computer system is, therefore, the single most important step in achieving a preventive maintenance program that satisfies maintenance, production, accounting, and stores.

The program should not be designed to dictate maintenance activities, but rather to allow for the controlled identification of data and easy to use menu driven screens for the selecting, generating, tracking, closing, and analyzing work.

The following features should be part of the chosen program:

System Control

A system control module should be provided for the maintenance of various control related entries for all the subsystems. A key screen in this module should be the security table update screen. Only the manager is given access to this screen for adding or changing the security tables. Users should be given either read or write capability on entire subsystem or specific screens within the subsystem.

All the control parameters and field validating entries are maintained in one file, each type being identified by a table code. For example, valid system codes are maintained in one table, component codes in another table, etc.

PM and CM Data Entry and Update

The program should provide various screens which allow the users to define the equipment and activities to be applied to the maintenance program. The user should be able to access data by either a system defined ID or by the equipment ID via cross-referencing. All user screens should be controlled by action codes which work in concert with the defined security to determine a user's level of allowable activity. In addition, screens which display all defined PM activities for a particular piece of equipment should be included.

The ability to offset PM start dates for equipment should be included. If a series of valves were all to be maintained at the same time, the work load may be unrealistic. This feature allows the user to offset the start date for PM activities for equipment so these valves, for example, may be scheduled in groups over a period of time.

Attachment H-1 (Continued)

Preventive maintenance activities can be scheduled by one of these methods:

- o A weekly batch job runs and schedules all PM's that are due based on their defined frequency and when they were last done. The time period that is examined is defined in a system control table.
- o The user can input a date range and one or more system identifications. The program will schedule all PM's that are due within the date range for each system.
- o The user can input a specific PM activity for a tag; the program will schedule that activity (PM override).
- o When corrective maintenance activities are processed, the program should check to see if any PM activities are due on the same tag. The PM due date must be within a percentage variance of the CM due date. This percent is defined in a system control table. Any such PM activities will be scheduled together with the CM activity.
- o Using the same criteria as above, PM activities that are due for any other tags within the same component group, if one exists, can be scheduled.

Component grouping provides for productive scheduling of work. If a given motor is to be worked on today and a related component in the system is to be worked on next week (requiring the motor to be taken off line), grouping of these items allows the program to suggest that both be done today. The program should provide controls so that this consideration is made only if the second item is near a user defined percentage of its PM life since last worked.

In the same light as component grouping, there are certain equipment tasks, which although not related in terms of determining when they should be scheduled, may need to be worked in a particular controlled sequence. Work order grouping allows the user to relate equipment activities in a predefined sequence under one controlled work order number.

The user should be provided with the ability to enter planned production outage data (type of outage and start and end dates). This provides criteria to be used in the load leveling process as well as in scheduling or for establishing due dates for work segments.

Scheduling

This should be the day-to-day work horse of the program. As the PM Data Maintenance provided for recurring defined PM activities, this provides for the on-line entry of non-recurring work such a corrective or plant modification activities.

Attachment H-1 (Continued)

Corrective maintenance work is entered into the program as a "non-recurring activity" and assigned a due date.

For cases where tag numbers are not known, the user can specify data items such as equipment name. When a CM is "processed" on-line by the user, it becomes a maintenance candidate. At this time it is assigned a work segment number. After the segment has been selected by the planner, he may generate the work order. The work order number is assigned at work order generation.

Automatic running of a scheduling program which identifies maintenance candidates using the data established in the PM data base, all the equipment grouping relationships developed in the scheduling support module, and historical data informing the program when tasks were last done on equipment should be included. Manual initiation of this program for selected equipment and activities or even entire systems if they are involved in a planned production outage should also be provided.

Planners should have the capability to group maintenance candidates into any number of planner files. After supplying a date range to be examined, planners should have the capability to establish criteria for retrieval, i.e., include or exclude candidates that meet one or any combination of the following criteria:

For example -

- a given activity (code)
- a given activity basis
- all PM's
- all CM's
- a given plant status
- a given system
- a given tag
- a given component group
- a given responsible maintenance group (shop)
- a given work order group
- a given component type
- a given priority
- etc.

Once the planner file criteria are established, the planner can initiate the retrieval process. This causes the program to retrieve all candidates that meet the criteria. After the candidates have been retrieved, the planner can list them on a hardcopy and select work from the file.

The result of this scheduling effort is a very complete maintenance candidate file which is available to planners for selecting work to be performed. Through resource analysis screens, planners view the amount of work available versus the resources available. Using data such as priority, area, responsible maintenance groups, etc., planners can move work to

Attachment H-1 (Continued)

fit operational and resource requirements to assemble effective work schedules. Once selected for work order printing, other planners can review these candidates but not select them unless released by the selecting planner.

The planner can now print work orders for selected candidates in a specific planner file automatically or manually. Automatic generation will cause the system to print all work orders that the planner has selected. Manual generation presents the planner with each selected candidate (or work order group) one at a time. He can then indicate whether or not to generate a work order for the candidate. After a work order is printed, the candidate is removed from the planner file.

Once selected, and crew scheduling is applied, maintenance candidates are printed on work orders for distribution to the maintenance staff.

In order to review plans for work not yet completed and to generate work schedules, the planner will utilize features discussed in Backlog Analysis.

The planner should be able to review all scheduled activities for given pieces of equipment. This provides a look at all work which may be associated with a work request written in the plant.

Backlog Analysis

The program should consider all maintenance candidates as backlog. Since the program should allow scheduling work weeks ahead, it is available to the planner for evaluation. The program should allow a planner to set up a number of standard backlog evaluation criteria sets. For example, if a planner works with all items in a certain set of systems, the system criteria can be set in advance. Then the planner can call out various backlog lists for all related candidates. For instance, the first being 3 weeks out, then 2 weeks and finally for just the week ahead to be planned. The screen used for selection should also allow the user to define various sorts of the same data.

A screen program should provide a graphic display which allows planners to monitor the backlog to see if it is under control.

Other program features should provide for monitoring and maintaining the material allocations associated with spare parts or tools used in performing maintenance work. Screens should be provided that give the user the ability to look at all stock required for a given maintenance candidate or to look at a stock number and see all the candidates requiring the item. A function of this effort is the ability to generate a stock requirements listing for all work in the backlog. This listing can be used in conjunction with a material management function as a manual interface if a programmatic interface isn't available.

Attachment H-1 (Continued)

Load Leveling

The program should review all the maintenance candidates and the outage schedules entered. It looks at all the work selected and assigned to work orders and shifts the due dates to fit the work into periods having available resources. The program should provide graphic display of the resulting work shifts to allow for planner review and resetting of due dates if necessary.

Load leveling allows the user to level out the peaks in maintenance activities. It examines the maintenance candidates' labor requirements and assigns new due dates to non-selected PM's in order to spread the requirements more evenly over time. The original due date should always be retained. While the program should take into account corrective maintenance requirements, it should not alter their due dates. The program should not alter due dates on PM or CM candidates that have been selected or that have work order generated.

The user should specify two parameters. First, the spread type selection: before, after, or both. This informs the system in which direction the due dates can be moved. Second, is the maximum percentage slip. This informs the system of the maximum amount of time it can move a candidate from its original due date. The time is computed based on the frequency and the specified percentage.

For example, if a candidate has a yearly frequency (365 days) and the schedule slip is 10%, the program should not move the due date more than 36 days away from the original due date.

Maintenance Forecasting

The program should provide the ability to consider not only the current backlog of work in the Maintenance Candidate file, but to also pull work for periods into the future. The periods should be user defined (i.e., weeks, months, quarters or years) and allow the user to generate "what-if" scenarios. The user should be able to further restrict the activities to be included in the analysis. This tool is valuable for planning resource requirements and budgeting efforts. The user can review the work forecasted, using either graphic displays on the terminal or through detailed printouts.

Attachment H-1 (Continued)

History Analysis

The key to having a computerized maintenance program is the ability to close the loop. When work has been completed, the program should allow the user to enter work order completion data identifying actual manpower and material to fulfill the maintenance task. All the historical data should be passed to a history data base while the completion date is maintained in the PM data base. This allows the scheduling program to review this date and introduce a new maintenance candidate when the work is next due, automatically.

The program should provide for a number of analyses of the data captured. For example, an equipment ID can be entered and all the work done to the item would be displayed. Specific activities for equipment can be entered and the user can review all the data related to the work done in the past. This can help the maintenance engineer modify PM requirements to fit actual plant and equipment requirements.

Specific analyses should be provided to measure the ratio of PM to CM. These reports allow the user to measure the effectiveness of the PM program to add, change or delete PM requirements based on actual results. These analyses can also signal when there is missing PM activities which should be defined for equipment.

Network Planning Support

The program should provide for the user who will interface data with a networking tool such as PREMIS, PROJECT/2, GC/CUE, etc. by use of associating activities. The association relates activities to successor or predecessor activities, the lag time involved, and the type of connection (start-finish, finish-finish, etc.).

PM Data Analysis

Typically, many individuals provide input to the PM data base. Although individually defined PM programs may appear very appropriate, the culmination of all the PM data input may be impractical or unrealistic.

The analysis allows the user to monitor data as it is generated and review its impact. The flexibility of these analyses provide the ability to spot potentially erroneous data and to single out the causes of problems.

PM Scheduling & Support

The program should provide the ability to establish relationships between equipment and activities which will provide a more effective and productive maintenance effort.

Attachment H-1 (Continued)

B. Generate Facility-Wide Equipment List

A facility-wide equipment list should be generated in order to establish the facility inventory of equipment. This list should be computerized to allow efficient sorting. During the inventory, each piece of equipment should be uniquely tagged. Since the equipment list and the PM program are computerized, the tagging system need not be complicated; a random number system can do. In actuality, however, it may be desirable to use a simple coding system to differentiate between different groups of equipment. For example, valves may be categorized as follows: GV-NNNN (where GV = globe valve and NNNN = an individually assigned number). All other characteristics of the valve will be contained in the equipment list data base.

It is suggested that the equipment list data base contain the following fields:

- Tag number
- Serial number
- Equipment type
- Manufacturer
- Model number
- Purchase order number
- Date purchased
- Location in plant
 - Plant number, area, elevation, room, etc.
- System
- Location in storage (If stored)
- Equipment description
 - Size
 - Capacity
- Equipment cost
- Equipment code
- Equipment condition code

The list should be as accurate as possible and be verified by actual facility walk-downs.

C. Assign Equipment to Logical Systems

In order to schedule PM and/or CM efficiently with minimum impact on production; equipment should be assigned to logically developed systems. That is, if work is scheduled in a piece of equipment in a system causing the system to be down, there may be other work that can be also accomplished at the same time. Conversely, if a system is down due to a production problem or new equipment installation or for any reason other than maintenance, all the equipment assigned to the system can be queried to determine if maintenance can be done at the same time.

Attachment H-1 (Continued)

Therefore, the assignment of equipment to logically developed systems should be accomplished keeping the above scenarios in mind.

D. Establish a Maintenance Library Concept

For any PM program to succeed, a library of documents used for maintenance must be established and properly maintained. Procedures for the establishment and maintenance of the library must be written. Control of documents should be included as part of the procedures.

Establishing the library concept involves development of the guidelines to be used to start a library, and a schedule for completion of milestones. The following types of documents should be considered for storage in the library:

- Equipment technical manuals
- Government regulations (maintenance related)
- Controlled documents

- Drawings -
 - Equipment
 - Plants
 - Systems

Establishment of a computerized catalog would be a plus. This can be accomplished very economically.

E. Develop Project Procedures

With the establishment of a PM computer program and a maintenance library concept completed, the next step is to develop project procedures. The development of a PM program should be considered as a project with a start date, objectives, goals, milestones, end date, and procedures describing how to conduct the project. It is suggested that a technical writer be employed to assist with format, grammar, etc. Appendix B is a suggested outline for PM project control procedures.

PHASE II - IDENTIFY COMPONENT CANDIDATES

A. COMPONENT SELECTION

Once the systems are identified, the components in each system is reviewed for possible inclusion in the maintenance program. In order to qualify for the maintenance program, a component must be reviewed with regard to certain selection criteria. Although the final criteria are subject to approval, the following criteria can be used as an example:

Attachment H-1 (Continued)

- The component is located in areas of adverse environmental conditions during operation.
- If a failure occurs, the component will cause a forced production shutdown or a failure to meet regulatory requirements.
- The component requires periodic testing and/or inspection per regulatory requirements.
- The component is such that, if certain maintenance were not done, the risk of personal injury would increase.
- Repair of the component due to failure could be potentially excessively expensive.

Any component that meets one or more of the criteria would then be considered as a candidate for the program, and its component data entered into the component portion of the program data base. A list of minimum component data that should be entered into the data base can be found in Appendix A.

PHASE III - IDENTIFY MAINTENANCE

After components are selected for the PM program, the next step is to determine what PM activities should be performed on each component.

A. Review of Existing PM Program

Review the existing PM program for each component selected for inclusion in the data base. Maintenance activities should be transferred to a component data input sheet, as applicable, in preparation for entry into the data base.

B. Review of Technical Manuals, Bulletins, etc.

Vendor technical manuals and technical bulletins should be reviewed and all maintenance activities extracted and entered on a component data input sheet. Spare parts and tools should also be entered if identified.

C. Review of Regulatory Documents

All documents which contain regulatory requirements should be reviewed to determine if PM is affected, and all maintenance activities extracted or developed and entered on a component data input sheet.

Attachment H-1 (Continued)

D. Review of Operational Conditions

At this point, all maintenance activities for a specific component will have been entered on a component data input sheet. However, certain operational conditions may require modification of some of the maintenance activities already entered.

For these situations, evaluate the conflicts and make the appropriate adjustments to the maintenance activity. The technical justification for the adjustment should be documented.

This method documents each divergence from the standard and provides an auditable trail and full traceability for each activity.

E. Addition of Engineering Judgment and Maintenance Philosophy

Maintenance philosophy and engineering judgment should be added to supplement the already identified maintenance activities. Engineering judgment includes, for example, adding a step to record motor amperage while performing a valve opening or closing test per a vendor technical manual.

F. Consolidation of Maintenance Activities

All of the maintenance activities for the component are reviewed together to provide a practical maintenance program. Duplications and overlap of maintenance activities are eliminated at this step. Additionally, the relationship of the component to its system and connecting systems is reviewed to insure that the effects a maintenance activity may have on other components in the same or adjacent systems is taken into account. The component's duty cycle, location, and operating environment are all evaluated for possible changes to maintenance activities.

PHASE IV - COMPUTER INPUT

A. Completion of Data Input Sheets and Loading

The completed data input sheets for each component are loaded into the data base.

B. Completion of Maintenance Recommendations for the System

Phase III and Phase IV A are repeated for each component in a system.

Attachment H-1 (Continued)

PHASE V - REVIEW AND APPROVAL

There are two steps to the review and approval process; a Preliminary Review and a Formal Review. The Preliminary Review is conducted informally by Maintenance Engineering personnel and the Formal review is conducted by Maintenance, with Production and other cognizant personnel at joint meetings.

A. Preliminary Review

This is a system by system review conducted entirely by maintenance personnel. The review is done by the system cognizant engineer and component and/or maintenance experts as required.

This review pulls the system maintenance together and inserts experience, practicality and efficiency into the maintenance program. Technical Justifications are reviewed, modified, deleted, and/or generated. The maintenance for each system is fine tuned in preparation for the Formal review. The completed computer generated system printout and copies of the Technical Justifications are provided for review at the Formal review meeting.

B. Formal Review

The Formal review is a joint maintenance/production meeting. Computer printouts of the system or systems to be reviewed are furnished to each attendee. System diagrams, Technical Justifications and any applicable supporting documents are also brought to the meeting.

All personnel with expertise in the system, maintenance, component operation, operations, etc. should be invited to attend. All comments are documented and resolved by maintenance, and if necessary, sent through another preliminary and formal review cycle as identified in the Flow Chart.

It is expected, from prior programs of this magnitude, that the first few systems may require a large expenditure of time to review. After this, a typical system will require significantly less time. Through component grouping, review times can be significantly reduced.

Appendix A

SUGGESTED INPUT FIELDS FOR A PREVENTIVE MAINTENANCE PROGRAM

I. The following information should be entered into a data base for equipment requiring preventive maintenance:

A. Equipment Nameplate Data

- Plant Code
- System Code
- Equipment Identifier
- Engineer's Initials
- Equipment Name
- Equipment Drawing/Revision
- Equipment Manual Description
- Manufacturer
- Manufacturer Code
- Manufacturer's Model No.
- Vendor
- Vendor Code
- Purchase Order No.
- System Drawing/Revision

B. Equipment Tag Data

- Equipment Tag Number
- Location
- Drawing Location (Zone)

C. Maintenance Activity Data

- P.M. Activity Number

- Activity Description
- Priority
- Procedure Number
- Activity Code
- Activity Frequency
- Activity Time
- Production Status
- Activity Basis
- Responsible Maintenance Group
- Number of Men
- Skill Code
- Duration Time Per Skill

II. The following information should be entered into a data base for equipment not requiring preventive maintenance:

A. Equipment Nameplate Data

- Plant Code
- System Code
- Equipment Identifier
- Engineer's Initials
- Equipment Name
- System Drawing/Revision

B. Equipment Tag Data

- Equipment Tag Number
- Drawing Location (Zone)

Appendix B

PREVENTIVE MAINTENANCE PROGRAM SUGGESTED PROCEDURE OUTLINE FOR PROJECT CONTROL

- I. Identification of Candidates for Inclusion in the Maintenance Management Program
 - Purpose
 - Applicability
 - Definitions
 - Implementation
 - Selection Criteria
 - Selection of Candidates
 - References
 - Attachments
- II. Determination of Preventive Maintenance Requirements
 - Purpose
 - Applicability
 - Definitions
 - Implementation
 - Steps to be Followed
 - Engineer's Work Book
 - Generation of Technical Justification Sheets
 - Disposition of the Engineer's Work Book
 - References
 - Attachments
- III. Completion of Data Worksheets /Input to Computer Database
 - Purpose
 - Applicability
 - Definitions
 - Implementation
 - Minimum Fields Requirements
 - Minimum Required Fields for Included Components
 - Minimum Required Fields for Excluded Components
 - Critical Fields
 - Data Input Formats
 - References
 - Attachments
- IV. Formal Review/Approval/Revision of Preventive Maintenance Plans
 - Purpose
 - Applicability
 - Definitions
 - Implementation

- Internal Engineering Review
- Initial Formal Approval
- Approval of Revisions of the Plan
- Update of Controlled Copies of the Printout
- References
- Attachments

V. Documentation Control of the Maintenance Program

- Purpose
- Applicability
- Definitions
- Implementation
 - Changes to the Program
 - Technical Justification Sheets
- References
- Attachments

VI. Assignment of Codes

- Purpose
- Applicability
- Definitions
- Instructions
 - Responsibilities
 - Component Codes
- References
- Attachments