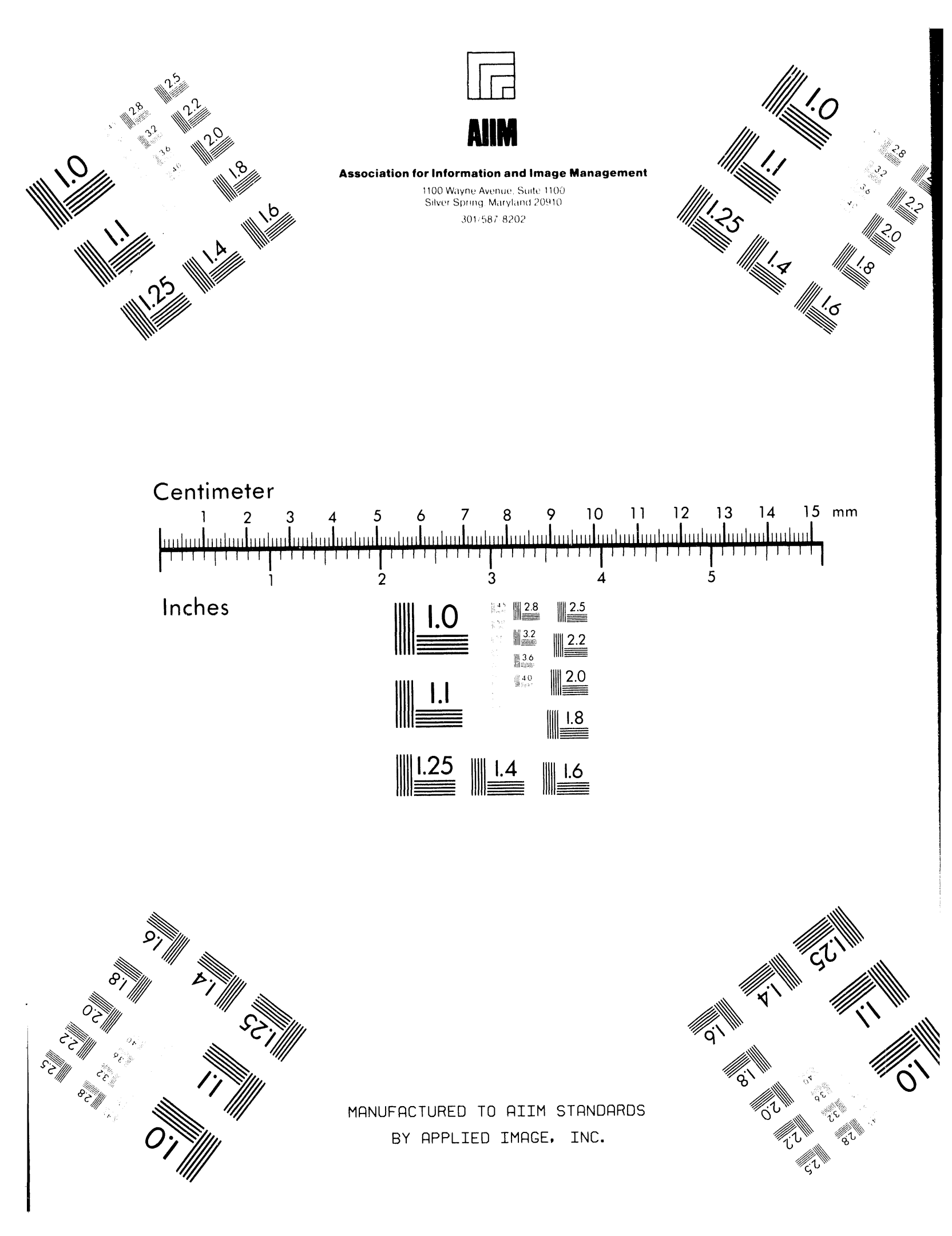
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GENERAL ELECTRIC

HANFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

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BASIS FOR DESIGN SCOPE

PLUTONIUM RECLAMATION FACILITY - Z PLANT
PROJECT CAC-880

By

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Products Design and Development
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April 27, 1960

Submitted by:

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5/13/60
Date

Approved by:

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Facilities Engineering Operation
Chemical Processing Department

5/13/60
Date

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BASIS FOR DESIGN SCOPE

PLUTONIUM RECLAMATION FACILITY - Z PLANT

PROJECT CAC-880

I. DESIGN CAPACITY

The design capacity for the Plutonium Reclamation Facility will be 300 kilograms per month or 3600 kilograms per year of plutonium. The make-up of feed material will be assumed as follows for the design basis, realizing that the actual feed composition may be slightly if not appreciably different:

Type of Material	Plutonium Kgs/Yr	Dissolver Feed Cans/Yr
Slag and Crucible	180	11,900
Metal	630	630
Skulls	1,370	1,370
Powders	600	1,500
Liquids	820	--
Total	3,600	15,400

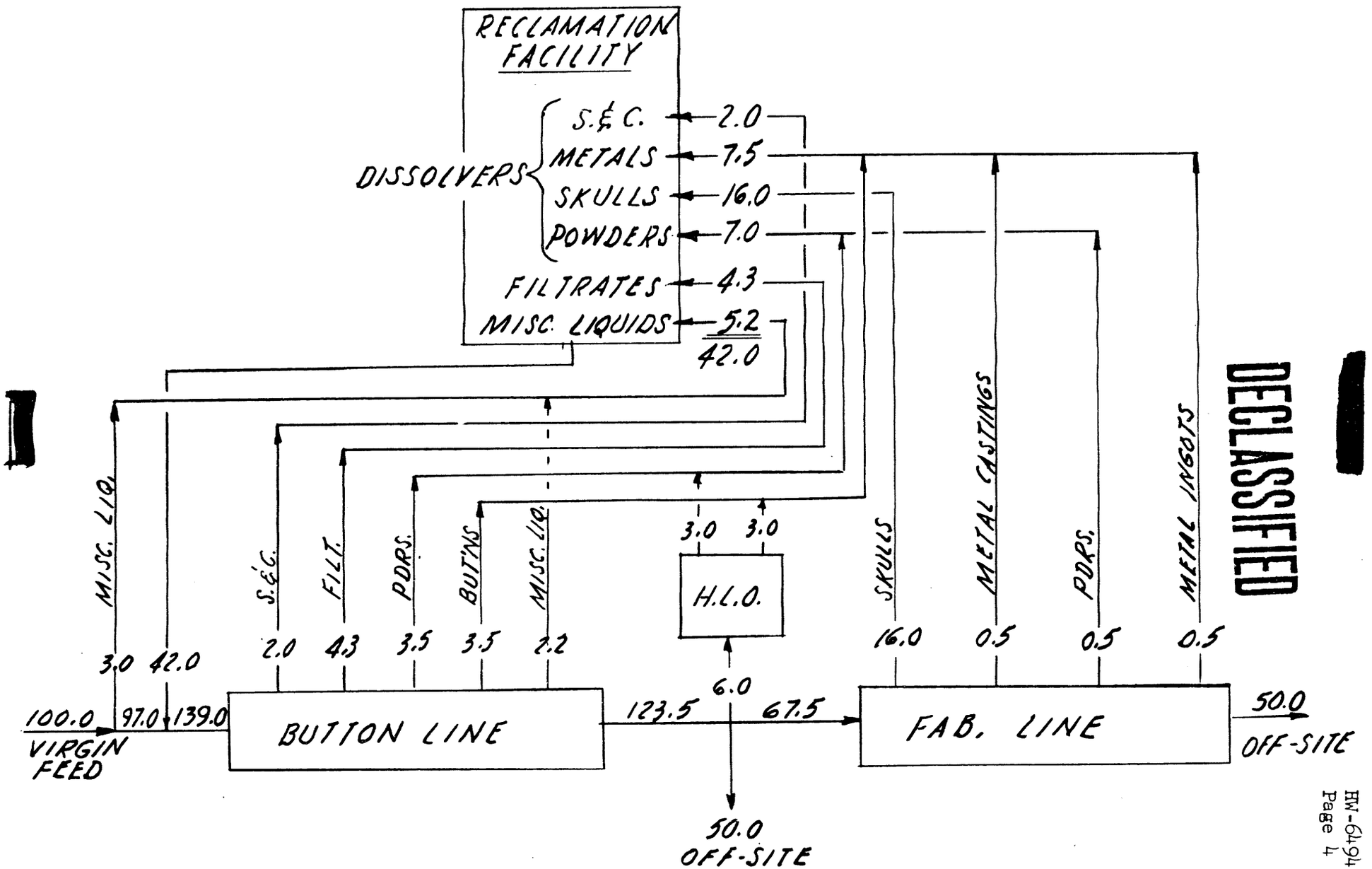
It should be emphasized that the subject facility, as the name implies, must be extremely flexible in its ability to handle a wide variety of feed materials. The new facility will be designed to process the above quantities of materials when operating on a three-shift day, five-day week, 40-week year with an overall efficiency of 75 percent; twelve weeks per year will be required for "turnaround" time to enable campaign operation for segregation of feed plutonium by isotopic content.

II. ESTIMATED THROUGHPUT RATES

The basis for estimating feed materials to the subject facility as a function of the amount of virgin feed material to Z Plant is shown in Figure 1. This average material balance results in the following amounts of plutonium recycled to the new facility, expressed as percentages of the virgin feed material supplied to Z Plant:

Slag and Crucible	2.0%
Metal	7.5%
Skulls	16.0%
Powders	7.0%
Filtrates	4.3%
Misc. Liquids	5.2%
Total Recycle	42.0%

FIGURE 1
Z-PLANT MATERIAL BALANCE



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The virgin feed load to Z Plant, as forecasted in document HW-62764, "Basis for Preparation of Plant Improvement Programs - Chemical Processing Department," by W. K. MacCready, will result in the following loads to the new facility by using the material balance percentages shown on Figure 1:

Type of Material		*Hanford	**Other	Total
Slag and Crucible	Kg/yr	140	18	158
Dissolver Feed	Cans/yr	9,870	1,230	11,100
Metal	Kg/yr	530	66	596
Dissolver Feed	Cans/yr	530	66	596
Skulls	Kg/yr	1,140	142	1,282
Dissolver Feed	Cans/yr	1,140	142	1,282
Powders	Kg/yr	500	62	562
Dissolver Feed	Cans/yr	1,250	155	1,405
Liquids	Kg/yr	675	84	759
Total	Kg/yr	2,985	372	3,357
	Cans/yr	12,790	1,593	14,383
Button Line Load	Kg/yr	9,869	1,227	11,096
Virgin Feed Load	Kg/yr	***7,100	883	7,983

* Includes Normal, E, and NPR plutonium.
** Includes NPF, PRTR, and UK plutonium.
*** Expansion case; base production is 6,100.

The numbers in the above tabulation designated as "Dissolver Feed" are based on continuation of the current practice of packaging all solid feeds from the button lines for recovery. If a technique such as slurrying or vacuum conveying can be developed for transferring solids, packaging of "Slag and Crucible" and "Powders" will be materially reduced.

If capacities and processing capabilities greater than the above are required to process off-site plutonium scrap other than that included in the "Other" column in the preceding tabulation, a design scope change would be required and additional funds would probably be requested from the A.E.C.

III. BASIC PROCESS

The new facility will utilize a tributyl phosphate-carbon tetrachloride solvent extraction flowsheet, basically the same as the present Recuplex facility, with technological improvements to increase processing capabilities.

The major flowsheet differences between the present Recuplex facility and the new facility are as follows:

1. All dissolving will be performed in continuous critically-favorable dissolvers. These continuous dissolvers will be designed to handle slag and crucible, powders, and oxidized metals and skulls.

2. The present solvent extraction column and scrub column will be combined into a single CA column to achieve lower CAW waste losses and eliminate intermediate pump tanks.

3. A continuous organic wash column will be provided, primarily to reduce plutonium losses to the CAW stream, the major process waste loss.

4. Flowsheet changes will be made to decrease the amount of plutonium in the CAW stream from the present 0.006 to 0.0003 grams of plutonium per liter. This may require the installation of one additional solvent extraction column for continuous clean-up of the CAW stream, depending upon the results of development studies now being made on the previous item.

The new facility will not contain equipment for processing plutonium-uranium, plutonium-thorium, or plutonium alloys with other actinide elements. If processing of these materials is required, it would represent a scope change and additional funds would be requested from the A.E.C. for the installation of a partition cycle in the new facility.

IV. FEED ACTIVITY

The new facility will be designed to process plutonium which has been exposed to high irradiation levels in the reactors. Gamma and neutron shielding will be based on the following feed isotopic composition:

1. Plutonium-238: less than 0.1%
2. Plutonium-239: greater than 65%
3. Plutonium-240: less than 20%
4. Plutonium-241: less than 10%
5. Plutonium-242: less than 5%

V. PROJECT COSTS AND COMPLETION DATE

The Chemical Processing Department project target cost to provide a new reclamation facility is $2,900,000. All portions of the project will be handled with the realization that this figure cannot be exceeded. Accordingly, any process refinements and additional supporting facilities or equipment will be provided only to the extent that they do not jeopardize the overall project target cost. High standards for industrial and nuclear safety are to be maintained. Although the design scope basis for many of these supporting facilities is discussed in subsequent paragraphs, the degree to which they are ultimately included into the final facility will be a function of their compatibility with the overall project cost target.

Beneficial use and project completion dates will be established during the Title I scoping period. However, all phases of the project will be handled in such a manner that project testing and start-up are completed by June 30, 1963. Further, it is recognized that the need for this new facility is extremely urgent and, therefore, exhaustive studies will be made to determine methods of improving the project completion date. Deviations from the above cost and schedule requirements must have the prior approval of the Manager, Facilities Engineering Operation. A preliminary project schedule is shown in Figure 2.

VI. SEGREGATION AND CAMPAIGNING

Although the new facility will be capable of handling feeds from HAPO production reactors, PRTR, and off-site power reactors, it will not have the capability of handling these streams, or any other streams that must be segregated, simultaneously. Segregation of any given feed stream can be accomplished only by campaign-type operation. Accordingly, the design rates and throughput rates discussed in Section I and II of this report are based on the premise that three campaigns will be required to process the PRTR, NPF, and UK feed materials and that two weeks "turnaround" time must be allowed at the beginning and end of each of these campaigns.

VII. NUCLEAR SAFETY

Nuclear safety will be achieved to the fullest possible extent by the use of geometrically-favorable vessel dimensions and vessel arrangements. Nuclear safety for exceptions to the above statement normally will be maintained by neutron monitoring and/or administrative control. Nuclear safety calculations will be based on the following criteria: (1) plutonium concentrations do not exceed 450 grams per liter; (2) all tanks are fully reflected; (3) the nitrate ion concentration in excess of that required for the plutonium present is greater than 1.5 molar; and (4) the plutonium-240 content of the feed plutonium will be not less than three weight percent.

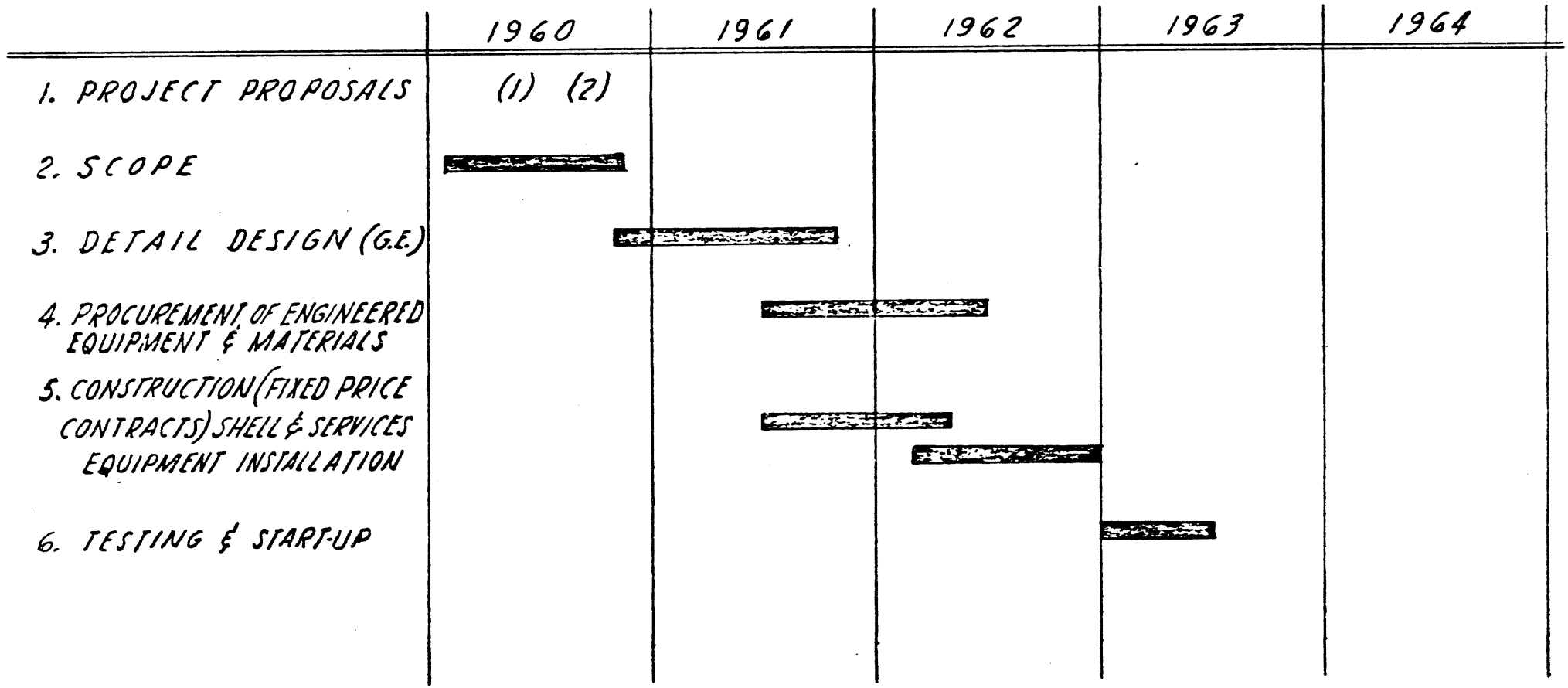
VIII. SHIELDING AND RADIATION PROTECTION

The basic criteria for specifying shielding throughout the new facility will be that feeds, with activities meeting the specifications set in

FIGURE 2

PROJECT CAC-880
PLUTONIUM RECLAMATION FACILITY - Z PLANT

PRELIMINARY PROJECT SCHEDULE



(1) REQUEST TO A.E.C. FOR FUNDS TO START DETAIL DESIGN.

(2) PROJECT PROPOSAL TO A.E.C. REQUESTING TOTAL PROJECT FUNDS.

Section IV of this document, can be processed continuously without radiation exposure to personnel becoming a factor in [illegible]umber of people required to operate or maintain the facility. [illegible]eneral, all areas normally occupied by personnel will be shielded [illegible]hat the whole body dose rate is less than 1 mrem/hr. The ope[illegible]ing gallery and control room will be shielded to reduce dose rates to less than 0.5 mrem/hr.

IX. DESIGN, OPERATING AND MAINTENANCE PHILOSOPHY

To the greatest extent possible, glove boxes will be minimized or eliminated. The primary reasons for this are the cost and loss of both accessibility and visibility that result from providing glove boxes with the required thickness of gamma and neutron shielding. For this reason, all process vessels will be located in a Zone IV area which will be shielded from the rest of the building with adequate shielding, probably in the form of concrete. Vessels and other process equipment in this area will be handled remotely using an overhead crane operated from a Zone I or Zone III area. Personnel entry into this Zone IV process cell area will not be required except under emergency conditions. Since technology has not yet been developed to permit the location of piping, valves, instruments, etc., in a Zone III area and since cost will prohibit the use of Purex or Redox canyon type jumpers and connectors, it will be necessary to locate all such equipment in glove boxes adjacent to the shielded process equipment cell. These glove boxes will be shielded to minimize gamma radiation to maintenance personnel; however, no neutron shielding will be provided. Neutron radiation is primarily a function of the quantity of plutonium present; since the equipment in the glove boxes will contain only small amounts of plutonium in comparison to that inside the process vessels, it will be assumed that neutron radiation to maintenance personnel working in the glove boxes will not represent a major problem. Development studies are underway to check the validity of the latter assumption and if these studies show the assumption to be incorrect, the design philosophy will be modified accordingly. All process control work will be performed in a central control room which will be designed essentially as a Zone I area, but which can be conveniently modified to a Zone III area in the event that operating management may desire to eliminate the need for a clothing change between the control room and the rest of the building areas. All routine operations performed in the control room will be remotely-actuated. If instrument air lines are run to the control room instrument panels, these air lines will be separated from those air lines in the process hood and to the process equipment by air-to-air transmitters located in a Zone III area, so that no contamination ever reaches the instrument panel. Shielded viewing windows into the process cell and/or closed circuit television will be provided for crane operation and general equipment observation.

X. FEED STORAGE

The following criteria and considerations will govern the specification of feed storage facilities for the new facility:

1. Feed inventories shall be minimized to the fullest possible extent;

2. All feed streams shall be processed as generated except under emergency conditions;

3. In emergencies, feed storage shall be provided by the Finished Products Operation outside of the new facility;

4. Storage of feed materials for this facility only shall be provided; Project CGC-813 incinerator facility feeds shall be stored elsewhere;

5. No storage shall be provided for feeds accumulated as a result of the requirement for campaign operation; such storage facilities shall be provided by the responsible project, such as NPF or NPR;

6. Manual handling of feeds shall be minimized and/or handling systems shall be so designed that subsequent mechanization is compatible;

7. Feed storage shall be provided only to the extent necessary to eliminate disruption of production due to unduly close coupling between this facility and associated facilities; and

8. Maximum storage shall be provided within the limit of project funds.

XI. PR UNLOADING FACILITIES

A station will be provided in the new facility for unloading PR and RC cans. This station will be used primarily for unloading PR cans of off-specification material received from the Purex and Redox plants, and for unloading RC cans of material received from the Analytical Laboratory and the Project CGC-813 incinerator facility. This unloading facility will also contain space for storing at least 6 PR or RC cans.

XII. MISCELLANEOUS TREATMENT ROOM

A miscellaneous treatment room will be provided to contain three glove boxes housing process equipment for the treatment of miscellaneous scrap: (1) the oxidation of metal and skulls; (2) the processing of ash from the Project CGC-813 incinerator building; and (3) non-routine operations such as leaching and dissolving, equipment to be specified by the Research and Engineering Operation.

XIII. EXPANSION

Adequate space will be provided in all portions of the facility for installation of additional equipment to handle such eventualities as:

1. The requirement of an extra dissolver for processing additional scrap from off-site sources;

2. The requirement of adding partitioning cycle equipment for processing plutonium - other actinide alloys; and

3. Equipment changes and/or additions warranted by process technology advances.

It is emphasized that additional space only, primarily in the process cell, will be provided for future installation of equipment within the limits of available funds. Further, within these same limits, the building structure and arrangement will be such that a future building addition is compatible.

XIV. MISCELLANEOUS

Project funds will be used to provide only that equipment directly associated with the process.

The new facility will be tied into existing waste disposal facilities. If, at some later date, any of the various waste disposal systems become inadequate, their replacement will be financed by another budget item.

D. E. Braden

D. E. Braden
Products Design and Development
Facilities Engineering Operation

DATE
FILMED
7/5/94
END