SOME CONSIDERATIONS ON FILM PROCESSING REQUIREMENTS AT SLAC

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SUMMARY

This note reviews the processing installations at LRL, BNL and ANL, and available processing machines. Recommendations for SLAC facility are made together with an outline of time schedule and cost.

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1.0 Introduction.

By the end of 1966 SLAC should start producing experimental film in quantity, raising to an estimated annual output of 3 to 11 million feet. Based on the experience of other laboratories, in-house processing facility will be required which in turn calls for considerable lead time and advance planning.

This should be a laboratory wide installation, permanent, inasmuch as a big portion of cost is in installation, and hopefully one that would avoid the mistake committed at all other laboratories where the size has been painfully underestimated and no room left for expansion. Hopefully this note will help us plan for such a facility, but as a concession to financial realities a "bare bones" operation is also considered.

Because of very high processing volume and quality required an ideal solution would be a special purpose building designed to house continuous processing and technical photography group which no doubt will be eventually required at SLAC. This solution would involve a 30 month lead time and initial expenditure of $240,000 to $320,000. An interim solution consisting of a single processing machine installed in 1800 sq. ft. of suitable existing space could give us a minimum capability by the end of 1966 for an estimated expenditure of $125,000. It appears at present that suitable space could be found in the existing Fabrication Building. With sufficient planning it may even be possible to provide for expansion potential for eventual establishment there of an integrated technical photography group.

2.0 Review of film processing capabilities of other laboratories.

I have recently visited film processing/technical photography department at LRL, BNL, and ANL. Following is a brief description of their operations.

2.1 Lawrence Radiation Laboratory, Berkeley - Technical Photography.

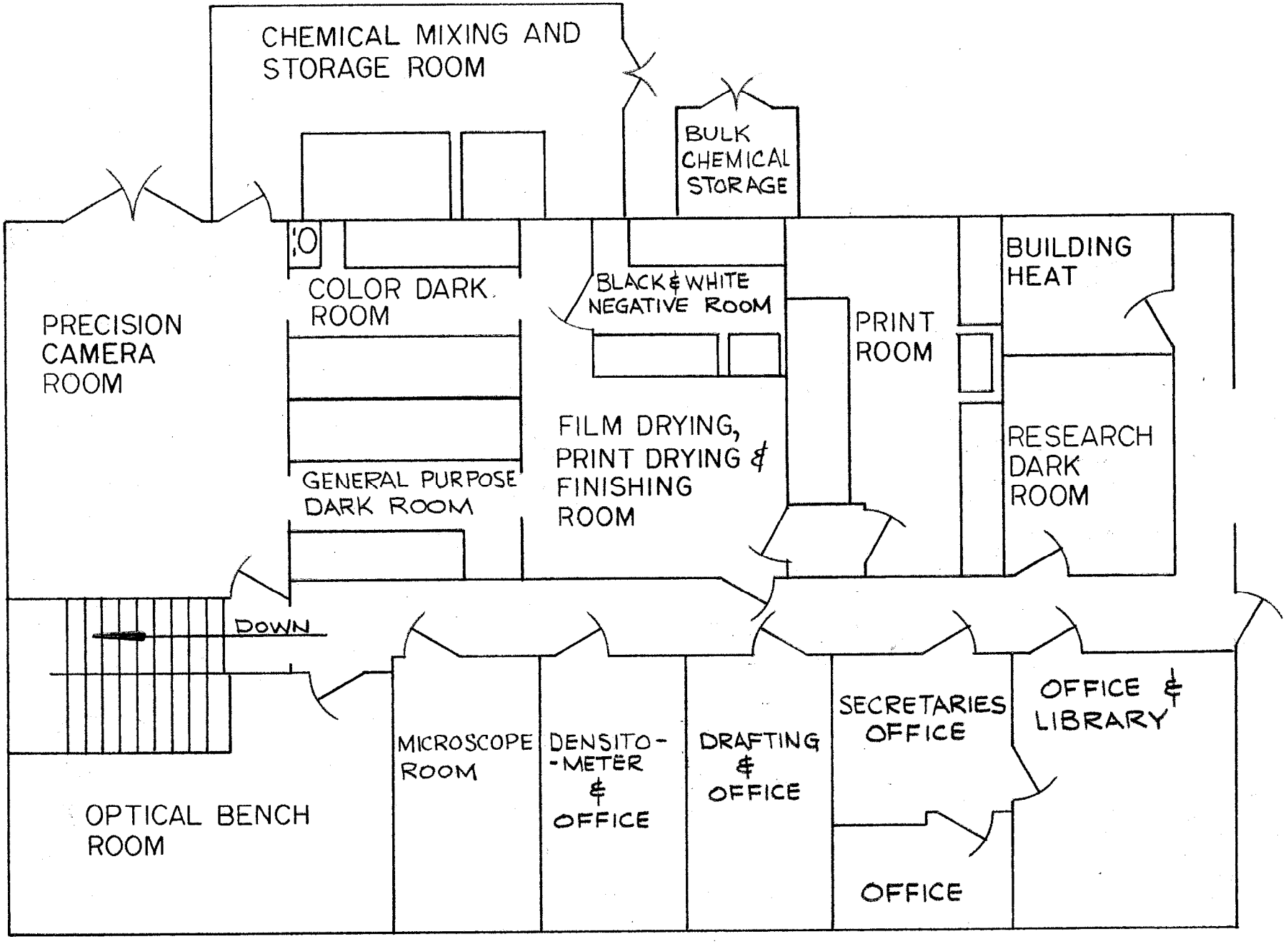
Roland P. Michael is in charge of a department responsible for all technical photography in the laboratory (but not graphic arts, slides, etc). In addition they run an optical bench facility in the department. Technical photography occupies 6400 sq. ft., the whole of 2-story building 47. About 3000 sq. ft. are used for continuous film processing. They operate two High Speed FC 200 processors (16 mm to 70 mm). In 1964 they processed 2.75×10^6 ft of film and up to now the volume increased every year. Berkeley operation is "on line", i.e., 24 hours, 7 days a week, and they aim for a cycle time of less than 45 minutes from removal of camera magazine to scanning of processed film. The department has a staff of 20.

Technical photography is responsible for ordering of all the film routinely needed by the laboratory for data recording. This is stored in rented freezer space. For details of the layout see plan enclosed.

Generally the floor space at Berkeley is on the generous side. It shows some defects due to adaptation of an existing building which could be avoided. Note that they use additional warehouse space for storing of chemicals, and freezer space for storing bulk film.

2.2 Brookhaven National Laboratory - Photography and Graphic Arts.

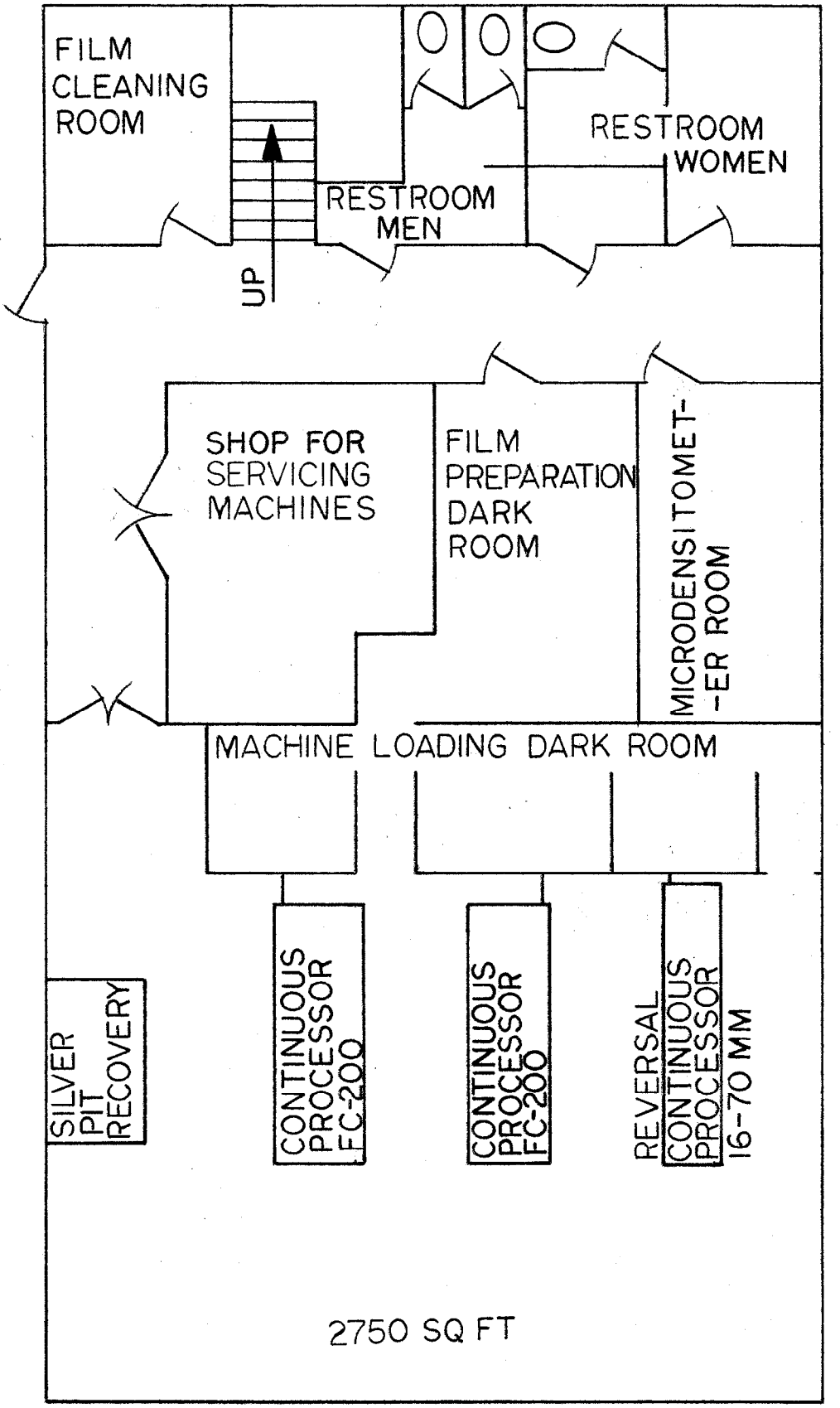
John Garfield is in charge, responsible for technical and graphic photography. Out of 8857 sq. ft. occupied by the department, the continuous processing section occupies 2200 sq. ft. and appears extremely cramped. They operate 2 High Speed processors with 5 people on 5 days a week, one shift, basis, and in 1964 processed 4.5×10^6 ft. of film. They have experienced some difficulties in drying thicker base film due to insufficient air conditioning capacity. Also their chemical storage tanks had to be increased to five 200 g capacity tanks from 100 g used elsewhere. Note that they also have a darkroom immediately adjacent to the 80" bubble chamber for processing test strips (approx. 100 sq. ft.).



1ST FLOOR.

LAYOUT OF FILM PROCESSING LABORATORY

L.R.L. (BERKELEY)
SCALE: 1/8" - 1'0"



BASEMENT

L.R.L.(BERKELEY)

SCALE: 1/2" = 1'0"

2.3 Argonne National Laboratory - Graphic Arts.

John Dalquest is in charge of the department. Their floor space is 2020 sq. ft. Two High Speed processors are operated, on 2 shifts, 5 days a week. Their present output is 1.25×10^6 ft/yr, capability is estimated by Dalquest to be 5.5×10^6 ft. The space is well laid out, but rather cramped. Main drawback is difficult access for processing chemicals -- no room for a fork lift truck, and lack of storage space. (Apparently a universal problem.) They would like to have a continuous 16 mm - 35 mm processor but have no space for it, and have to use an outside E.K. facility. They have their own 900 cu. ft. deep freezer storage, (0°F), (not included in the 2020 sq. ft.) for film and have no problem with loss of latent image. For details of the layout see plan enclosed.

3.0 Estimate of required film processing capacity.

This estimate has been prepared in two ways which probably represent the high and low limit of SLAC future processing requirements.

3.1 A "gross" estimate of 11 million feet of 70 mm film per year, based on a fraction of accelerator pulses per year.

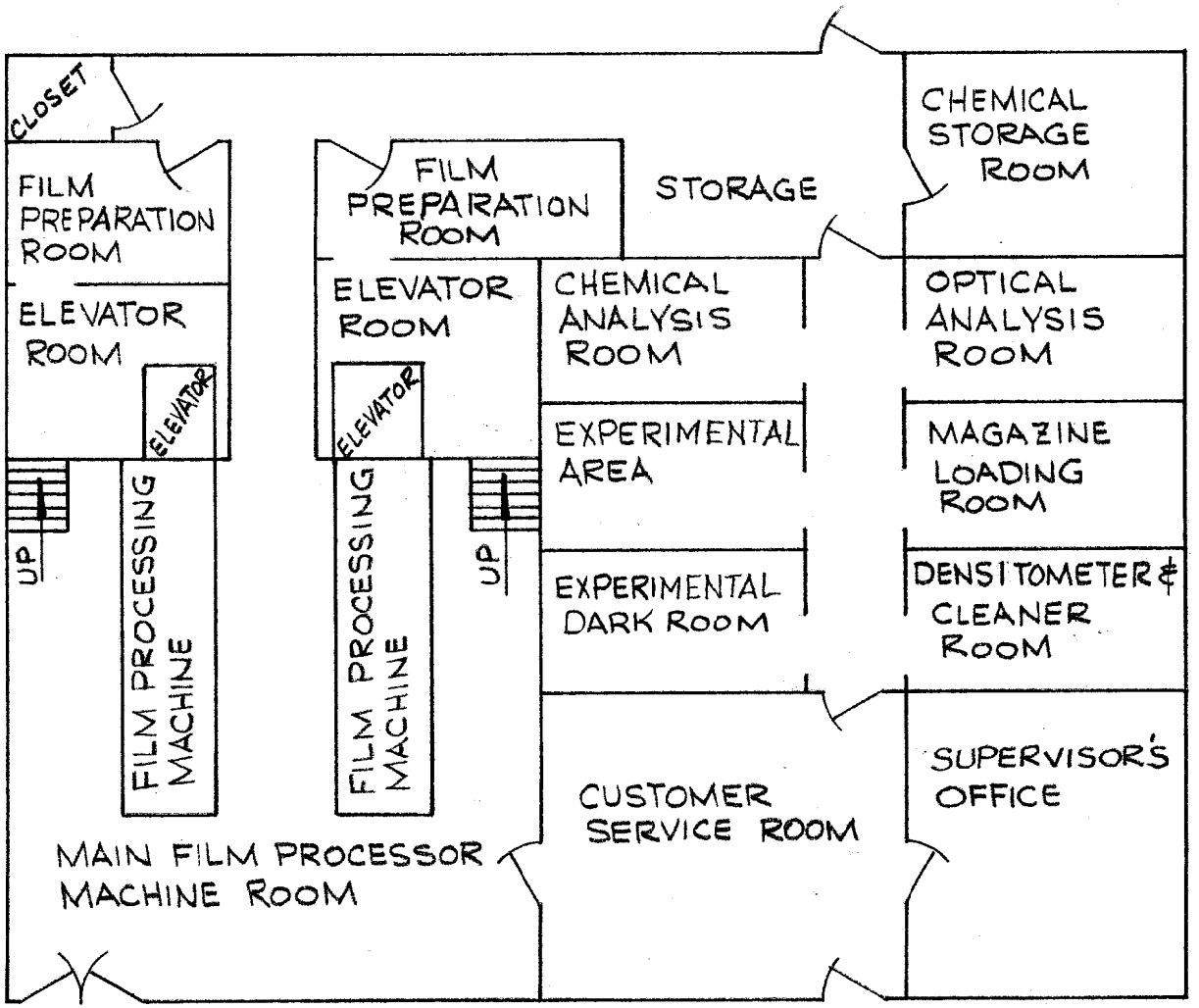
3.2 A "detailed" estimate of 3 million feet of 70 mm film per year, based on declared processing requirements of the various experimental groups.

The details of the method of arriving at the above estimates are outlined below:

3.1 Gross estimate - 11×10^6 feet 70 mm film per year.

Based on:

(a) Accelerator running 16 hours/day
(b) On 40% duty cycle
(c) .5% of beam pulses recorded photographically
(d) With 80% efficiency
(e) Each recorded even requires 2 frames 140 mm long (i.e., 11" of film)
(f) No film loss



ARGONNE NATIONAL LABORATORY
LAYOUT OF FILM PROCESSING FACILITY

SCALE: $\frac{1}{8}$" = 1'0"

3.2. "Detailed" estimate - 3×10^6 ft. of 70 mm film per year.

3.2.1 40" HBC

(a) 10^6 events for Joe Ballam plus $.35 \times 10^6$ events for Martin Perl. 7.85" of film per event. 10% of film wasted. = 10^6 ft of 70 mm film.

3.2.2 Group D Spark Chamber

(a) Estimate from R. Mozley:
$.4 \times 10^6$ events per year, 18" of 70 mm film per event, 10% waste. = $.66 \times 10^6$ ft. of 70 mm film per year.

3.2.3 Group E Spark Chamber

Estimate from M. Perl:
$.33 \times 10^6$ events per year, 11" of 70 mm film, 10% waste.
$= .33 \times 10^6$ ft of 70 mm film per year.

3.2.4 Visitors and other users

Assume 50% of film estimated in previous 3 sections
$= 10^6$ ft of 70 mm film per year.

4.0 Review of available film processing equipment.

Two types of machines are available, immersion and spray. Spray machines appear to be more suitable for our use on account of smaller size, daylight operation and, most important, better processing quality.

Processors can be obtained from the following sources:

4.1 High-Speed Equipment of Waltham, Massachusetts.

BNL, ANL and LRL (Berkeley) have 2 each of spray processors made by High-Speed. The machines are variations on model FC-200, and sell for between 54K and 57K depending on specifications. The users at above mentioned laboratories speak very highly of it. The only area where it is known to have given trouble is in processing thin base film. The machine consists of 4 sections:

(a) A darkroom loading section.

(b) Three (3) wet processing cabinets - one for developer, hypo and wash.

(c) An "impingement" drying cabinet.

(d) A take-off station, including take-off elevator, flanges driven by torque motors, inspection light and control panel. It is self-contained, runs at 50 or 60 fpm for normal gamma with top speed of 150 fpm, contains only 20 gallons of solution and in general appears satisfactory. It will, however, need improvements by the manufacturer to process thin base 70 mm film.

4.2 Houston Fearless Corporation of Los Angeles.

The company is probably the largest supplier of film processors to the military establishment. They make 35 to 70 mm processing machines, the "Super Lab 35/70" immersion machine and "Spray Lab Master" spray machine. They claim thin base film can be satisfactorily processed, but only in the Super Lab machine. The equipment is in the 30 K range. Their specifications will require detailed study but they will be the biggest competitors to High Speed.

4.3 Filmline Corporation of Milford, Connecticut.

Filmline makes both spray and immersion processors in the 35 mm to 70 mm range for about 32 K. No specifications on their machines are at present available.

4.4 Other suppliers.

Film processors can also be obtained from a number of smaller concerns many of whom specialize in custom machines. They are Fisher Oscar Company, Fonda Corporation, Andre De Brie, Ronan Engineering and many others. Before final procurement of equipment for SLAC a detailed study should be made of available equipment.

5.0 <u>Suggested requirements for SLAC processing facility</u>.

5.1 General comments.

(a) The whole research experiment depends on the information recorded on the film.

(b) Each 1000 ft. of film represents an investment of several thousands of dollars, in machine time, research equipment, salaries, etc.

(c) Therefore, only best quality work and, consequently, equipment can be tolerated in the film processing operation.

(d) Inasmuch as continuous film processing is inherently a production line rather than research type operation, it would be best set up as a service operation - a laboratory wide facility. A further consequence is that it should not operate "on line" as a lot of experiments will generate a lot of pictures in a short period of time, but infrequently. Therefore, test strip processors and refrigerated film storage should be provided.

(e) As a very large portion of the cost is in providing services and installation, the facility should be capable of growing with the laboratory and should be planned as a processing laboratory from the start.

(f) As a person with considerable photochemical experience is generally needed to head such an operation, it would be natural to combine it as a single department with all technical photography services.

5.2 Selection of processing machines.

The requirements for a processor are as follows:

(a) Film damage - none can be tolerated.

(b) Reliability - capacity for 24 hour a day production at least 5 days at a time.

(c) Speed - at least 50 ft/minute.

(d) Accessibility - constructed for easy maintenance.

(e) Flexibility - Capability to handle 70 mm through 35 mm films with normal and thin base, preferably without any mechanical adjustments.

(f) Operational convenience - Daylight operation, small size, low noise level, low chemical capacity, etc.

On the basis of presently available information only the High Speed equipment meets these requirements (except for operation with thin base film). As the machines are available on approximately 6-month delivery, final selection is not urgent and other machines would be investigated.

5.3 Number of machines needed.

High Speed processors are run at 50 ft/minute at LRL and 60 ft/minute at BNL. Thus, even assuming 2 eight hour shifts, 6 days a week at 80 percent efficiency, a machine would be capable of yearly output of 10^7 ft. of film a year. The capacity of a processing plant must however be measured in terms of flexibility and reliability as well as footage to be processed.

The factors to be considered are:

(a) Different emulsions and film sizes may have to be processed simultaneously.

(b) Extended complete breakdown cannot be tolerated.

(c) Experimental film output is not likely to be steady the year round.

Therefore, a minimum installation of two machines is recommended.

5.4 Estimate of space requirement (for continuous processing facility only).

(a) Room for processing machines:
Processors are approximately 13 ft. by 4 ft.
Assuming 2 machines with space for later upgrading to 3 we need a minimum of 32 ft. by 22 ft. = 700 sq. ft.

(b) 3 loading rooms, 6 ft. by 9 ft. = 162 sq. ft.

(c) Film preparation room for unloading of magazines attaching sensiametric strips, etc., 10 ft. by 15 ft. = 150 sq. ft.

(d) Chemical mixing room, 6 ft. by 15 ft. (3 100-gallon mixing tanks) = 90 sq. ft.

(e)	Chemical storage room, 7 ft. by 18 ft. (five 100-gallon storage tanks with room for 2 more)	= 126 sq. ft.
(f)	Chemical storage room 6 ft. by 10 ft.	= 60 sq. ft.
(g)	Processed film storage room, 6 ft. by 10 ft.	= 60 sq. ft.
(h)	Deep freeze, 12 ft. by 12 ft.	= 144 sq. ft.
(i)	Maintenance shop, 10 ft. by 15 ft.	= 150 sq. ft.
(j)	Office space, 10 ft. by 25 ft.	= 250 sq. ft.
(k)	Silver recovery unit, 5 ft. by 8 ft.	= 40 sq. ft.
	TOTAL	1932 sq. ft.
	Allowing for corridors and wasted space	2200 sq. ft. approx.

5.5 Comments on layout of continuous processing space.

(a) Chemical mixing area must be separated from film areas to eliminate chemical dust carry-over. It should be convenient to the loading dock.

(b) Maximum use should be made of gravity in transferring photographic solutions, maximum of one pumped stage, from mixing to storing tanks.

(c) Building should be well air-conditioned -- film driers generate a lot of heat.

(d) Walls of room housing processing machines should be sound absorbing -- processors are very noisy.

(e) Drains in form of open trenches seem best.

(f) A lot of attention should be paid to light switch and access design in dark rooms.

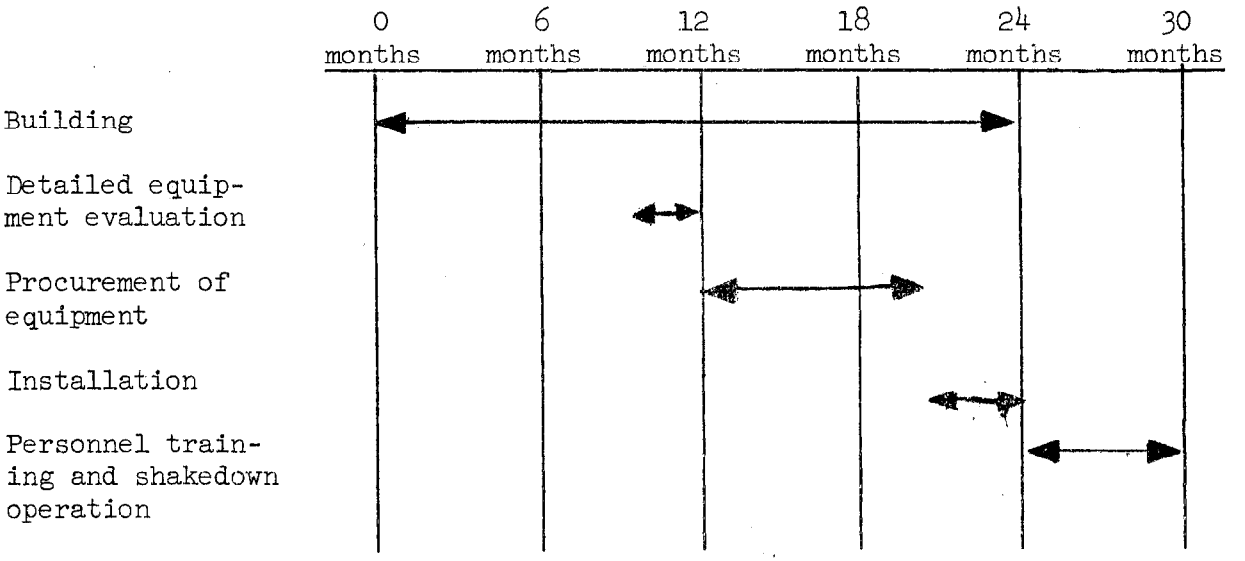
(g) Hot water supply must be adequate. Two fast action heating systems are preferable.

5.6 Overall space required for technical photography.

No detailed estimate has been made but to adequately serve this laboratory probably as much again as for continuous processing, i.e., 4000 to 5000 sq. ft. in total.

6.0 Schedule and budgetary estimate

6.1 Estimate of time schedule (assuming starting from scratch)



6.2 Budgetary estimate (assuming starting from scratch)

(a)	Building (continuous processing only) at $40/sq. ft. 2200 sq. ft. (assumed to include air-conditioning, water heating and softening and freezer space)	$88K *
(b)	Processing machines, 2 at 57K	114K
(c)	Silver recovery unit and accessories	10K
(d)	Three mixing tanks at 1K	3K
(e)	Five storage tanks at .6K	3K
(f)	Miscellaneous equipment	10K
(g)	Installation of equipment	10K
(h)	Initial stock of processing chemicals	2K
	Total cost of self-contained processing facility	240K

Assuming a 5000 sq. ft. building to handle whole of technical photography is constructed we have extra 2800 sq. ft. at $30/sq. ft. for a total cost of 323K

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*K = $1000

6.3 "Bare bones" budgetary estimate.

If we start with an existing building of 1800 sq. ft. modify it for 2 processors and silver recovery unit, but install only 1 processor the estimated cost would be:

(a)	Building modification	45K
(b)	Processing machine	57K
(c)	3 Mixing tanks	3K
(d)	5 Storage tanks	3K
(e)	Miscellaneous equipment	10K
(f)	Installation	5K
(g)	Initial stock of chemicals	2K
(h)	Rental of freezer space	.5K
	Total cost (exclusive of building)	125.5K