MONTHLY REPORT OF ACTIVITIES

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June 1, 1968

General

1. Status of Appropriation. The House Appropriations Committee hearings on the Public Works Bill, which includes our appropriation, have been held. The next step is the report of the Subcommittee on Public Works to the full Appropriations Committee, which will in turn report to the House. This is expected to occur some time this month. After action by the House, the Public Works bill will go to the Senate.

2. Site Acquisition. The time schedule for acquisition of the site by the State of Illinois calls for acquiring the village of Weston by October 1 and the complete site by December 31, 1968. Offers have been made for all the properties in Weston. We understand that there are now enough acceptances for us to be able to plan to move our entire operation to "The Campus," as we euphemistically plan to call it, in July.

3. Demise of the Accumulator. The accumulator (injection storage ring) has been dropped from consideration. Studies showed that it did not lead to reduction in the total estimated cost. No specific provisions

for a future accumulator will be incorporated in the present design, except for the "sentiment" of compatibility. A report on the accumulator study is in preparation.

4. Temporary Buildings. The Board of Trustees of URA has authorized the Laboratory to spend URA funds to construct another temporary laboratory building in the village of Weston. The building specifications are now out for bids. The building will be used jointly by the booster and rf sections until another temporary building is constructed for the booster section.

5. Central Building Complex. The buildings around the Central Laboratory Building have now been delineated and preliminary Title I drawings prepared. These buildings are now independent of the base of the Central Laboratory and their design and construction can proceed without similarly detailed knowledge of the Central Laboratory.

The Linac Equipment Bay is to the northwest of the central laboratory, between it and the linac enclosure. The Accelerator Service Area is to the southwest, between the Central Laboratory and the Booster. The Extraction-Hall Power-Supply Gallery is to the southeast, between the Central Laboratory and the Extraction Hall covering the long straight section of superperiod A of the main ring. The major entrance to the Central Laboratory will be from the fourth side, the northeast.

6. Central-Laboratory Design. A design concept has been chosen for the permanent Central Laboratory Building, out of a number of

exciting concepts created by DUSAF activities. It is in the form of a truncated cone surrounding an enclosed garden court. The building is 9 stories high in the present design.

7. Weston Open House and Teachers Workshop. An Open House was held in the air building on May 18. Many residents of Weston and other communities attended. A workshop for high-school and college physics teachers was organized by E. Malamud and held at Weston on May 25. Approximately 35 teachers from the area participated. Laboratory staff members discussed the accelerator and showed experimental work in progress. Another workshop will be held in September.

8. The Laboratory had 178 employees on June 1, including 50 scientists and engineers.

Theory

1. Computation. NAL is now obtaining satisfactory service on NYU's 6600 computer via the telephone data link. Until about two weeks ago we were plagued by numerous breakdowns of the computer itself (one lasting about three weeks), and bugs in the NYU programs that control the transmission. Early this month a two month complete rebuilding

of the NYU computer was begun. During this period Control Data Corporation is making a new computer at their Manhattan data center available to NYU and to the remote-terminal users. This computer is reasonably reliable, and the most serious bugs have apparently been removed from the transmission system. NAL now has immediate access to the computer for most of the day and turn-around time for jobs with moderate amounts of output is often less than one hour.

We have always received excellent service and help from Argonne's Applied Mathematics Division, which has made its two computers, a CDC 3600 and an IBM 360-75, available to us. At present we have a courier service to Argonne making three trips a day, soon to be extended to five. In addition IBM is furnishing very competent personnel to help convert 6600 programs to the 360.

2. Main-Ring Lattice. A small adjustment has been made in the quadrupoles of the long straight sections. Since the beam cross section is greatest there, these quadrupoles have been increased in aperture. To preserve focal length and pole-tip field, their length was also increased at the expense of about a meter of straight section length.

The lattice is quite stable against changes of ν . If all the quadrupole gradients are increased or decreased proportionately to cover a range of ν between 18.5 and 22, the maximum increase in B is less than 20%, except for the stopband at $\nu = 21$ of width $\Delta\nu \approx \pm 0.1$, due to the structure resonance arising from the six-fold periodicity.

3. Injection Energy. A study was made of the appropriate injection energy for a 5 Hz booster to be used in connection with the accumulator ring. Both cost and performance were considered. The conclusion is that 200 MeV is still the most desirable injection energy for such a booster.

4. Main-Ring Magnet Computations. The design work using the computer program TRIM for the main ring bending magnet is continuing. The effort so far indicates that field shapes well within acceptable tolerance can be obtained up to at least 18 kG without crenellation for both B1 and B2 magnets and the degree of saturation can be made quite small (about 3.5 % at 18 kG) and equal for both magnets. The proper coil configurations are 4 turns out of 12 placed between poles for B1 and 4 turns out of 16 placed in between poles for B2. With these coil configurations, the proper pole widths are approximately 8.5 in. for B1 and 8.8 in. for B2.

5. Secondary Beams. Studies are being made with A. L. Read of possible secondary beam layouts. One scheme is to channel a secondary beam through bending magnets and a set of three quadrupole triplets producing 360° phase advance from source to target, with a momentum-analyzing slit at an image point 180° downstream.

Main Ring

1. Model Work. The model measurements group has moved into the air building and is conducting tests on magnet-iron samples, vacuum-

system assembly, preliminary magnet-measurement apparatus, etc. The building is not uncomfortable except for very unsatisfactory acoustics. The specifications for the digital equipment needed for rapid model-magnet measurement have gone out for proposals.

Laminations have been received for the B2 magnet model from the stamper. The tolerances in the critical areas have been met. The burr is of the order of 2 mils which is about as expected with the very soft iron being punched. The stacking fixture is set up and stacking of the 3-foot model will proceed as soon as some of the laminations have been given an insulating coating.

The pulsed model power supply has been received from LRL and is being readied to drive the model. A water cooling system for the model has been detailed and is expected to be ready at about the same time that power is available.

The model vacuum chamber built last summer at the Physical Sciences Laboratory of the University of Wisconsin has been reassembled in the air building, using flanges and automatic flange-welding systems developed at NAL.

An Epstein Square permeameter has been built and is in use in magnet-iron testing.

2. Design Work. See the discussion under "Theory" above.

3. Plans for the Coming Month. The model magnet will be assembled, powered, and receive its first tests. The question of direct pulsing of

the main ring magnets from the power line versus flywheel energy storage will be resolved.

Linac

1. Linac Research Building. The group has occupied the linac research building and organized the surplus equipment within the building to start development work. The machine-shop equipment is in place and power installations and machine overhaul have started. The water and air distribution mains have been installed throughout the building.

2. Modelling Program. The 500 kW, 200 MHz amplifier-driver has been assembled and installed and will be ready to run as soon as the building power is available. The main power-distribution switchgear has arrived and installation of it and its associated power-distribution wiring will begin in the near future. The source test system has been assembled and will be complete and ready to operate as soon as ion pumps and primary power are available.

Cavity measurements of the effects of post couplers in the 200 MeV model have been continued in the preaccelerator pit of the research building. The tests so far verify the stabilizing effects of the post couplers and strengthen our opinion that this approach should be followed.

3. 10 MeV Linac. Design work on the 10 MeV cavity has been completed and the drawings and specifications forwarded to the purchasing department for bids. Design work is continuing on the drift tubes and

short preaccelerator columns.

The bids for the modulator have been evaluated and a contract is being prepared for procurement of this part of the rf system. The modulator will be received without a water-distribution monitor and its associated pumps and piping. This part of the system is now being designed within the group.

Bids have been received and evaluation of proposals has started for the preaccelerator power supply. Bids have been solicited for the control computer, the preaccelerator ion pumps, ion pumps for the 10 MeV cavity, and other minor components for the system.

4. Building Design. Preliminary Title I building drawings have been reviewed and design criteria developed for power and water requirements.

5. Plans for the Coming Month. Title I on the Linac building will be completed. Procurement of components for the 10 MeV linac will continue. Power tests on the 500 kW driver system will be carried out.

Booster

1. Booster Parameters. As a consequence of the decision to drop the accumulator, the original 15 Hz booster has been re-examined and updated. Booster parameters are summarized below:

Injection Energy	200 MeV
Final Energy	10 GeV
Radius	75.4717 m
Repetition Rate	15 Hz
Injection Mode	4 turns, 67.5 mA
Linac Emittance	0.9 π cm-mrad at 67.5 mA
ν_x	6.7
ν_z	6.8
Apertures	
<u>F Magnets</u>	
Horizontal "Good-Field"	5 in.
Horizontal Vacuum Chamber	
(Inside)	5.5 in.
Vertical Gap	2 in.
<u>D Magnets</u>	
Horizontal "Good-Field"	3.5 in.
Horizontal Vacuum Chamber	
(Inside)	4 in.
Vertical Gap	2.5 in.
Long Straight Section (rf cavity)	2.5 in.
Number of RF Cavities	18
Gradient Tolerances	
$\left(\frac{\Delta n}{n}\right)$ static	$\leq 0.5\%$
$\left(\frac{\Delta n}{n}\right)$ dynamic	$\leq 0.5\%$ (chamber eddy-current effects)
Magnet Excitation	
Turns per Pole:	
F Magnet	10
D Magnet	12

The radius is chosen to include the option for later two-turn or four-turn injection into the main ring.

The apertures are designed for an all-metal vacuum chamber.

2. Model Program. Magnet-lamination shapes have been determined and a contract let for model-magnet dies. Work on the stacking fixture

is proceeding. Model sections of a metallic vacuum chamber are being fabricated. Magnet-measuring methods are being developed.

3. Building Design. A preliminary draft of the Title I report on the booster building has been received from DUSAF and is being reviewed. An equipment bay extending from the main-ring external-beam Power-Supply Gallery to the Booster Equipment Gallery has been adopted for location of power supplies and support equipment for the 10 GeV transport system.

4. Plans for the Coming Month. The magnet-support system and the beam-transfer and synchronization system will receive concentrated attention. Review of the pre-Title I building drawings will be completed. The development and construction schedule will be reviewed. Parameters will be frozen for the injection, ejection, septum-magnet, and ejection-kicker systems.

Radiation Physics

1. Labyrinth Experiment. The first half of an experiment to measure neutron fluxes and doses along a labyrinth with three 90-degree bends was carried out successfully in the external beam of PPA. The data have been reduced but not yet analyzed. The experiment will probably be finished in June or July. The ORNL neutron physics division is trying to calculate these results.

2. Linac Shield. The linac shield was redesigned. Calculations in

progress to estimate neutron dose rates outside the shielding-wall penetrations indicate problems, but there are at least two ways to solve them. Additional moveable shielding can be used either inside or outside the shield, in front of the penetration openings. The shielding width is set by these dose rates rather than the flux passing through the shielding wall itself. New labyrinths and accesses were incorporated in this shield.

3. Cockroft-Walton Area. The neutron flux downstreaming from the linac towards the Cockroft-Walton area was estimated to give a dose rate of 4 mrem/hr. Some local shielding might be required if visitors will be allowed to peer at the C-W through windows.

4. Accelerator Service Area. The labyrinths between the extraction hall and accelerator support area, as well as between this area and the booster ring, have been redesigned to accomodate appropriate cul-de-sacs.

5. Skyshine. Some preliminary efforts have been made to estimate "skyshine" dose to areas surrounding the booster and main rings.

R. G. Alsmiller of ORNL has been asked to calculate muon leakage from the main ring tunnel. He is working on the problem.

6. Concrete Aggregates. A study of concrete aggregates is being made with the help of M. Goral (DUSAF) with the purpose of finding the lowest cost satisfactory heavy concrete for shielding.

7. Plans for the Coming Month. Studies will be initiated on beam dumps and penetrations for the booster and main ring. Production of hadrons and muons at 200 GeV is being studied.