LIQUID METAL FUEL REACTOR EXPERIMENT

MONTHLY PROGRESS STATEMENT

MAY 1957

BAW-1018

AEC CONTRACT NO. AT(30-1) - 1940
BAW CONTRACT NO. AEJ-46

SUBMITTED TO THE
UNITED STATES ATOMIC ENERGY COMMISSION
BY
THE BABCOCK & WILCOX COMPANY

LMFRE MONTHLY PROGRESS STATEMENT NO. 6

MAY 1957

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I. SUMMARY

The Research and Development program was completed. A project handbook, which is a compilation of data and constants, of interest within the project, was completed and issued.

A study of the shielding requirements indicated the necessity for test data. An in-pile loop will be selected for shielding experiments.

An alternate top end reflector arrangement has been proposed. The scheme utilizes a quadrant type graphite tank and a drilled block insert which is held down by key blocks and graphite screws.

Preliminary studies for inputs of reactivity without rod control indicate that for small reactivity additions the LMFRE system may oscillate on a fairly long cycle period.

Shielding calculations were made to determine the gamma spectrum at the core surface, fission product activity in the various component cells and required thickness of the reactor cell plug.

Reactor startup studies were completed for various rates of rod withdrawal speed and fuel circulation times. No difficulty is expected in obtaining a perfectly safe operating procedure.

Draft write-ups were released pertaining to the remote maintenance of the LMFRE.

Construction of four test loops for investigation of the suitability of Croloy 2¼ for use with liquid bismuth is progressing. Two loops will be fully annealed and two will be normalized and tempered.

The tilting capsule program is underway and is now checking chemical cleaning methods.

Procedures are being developed for analyses of uranium, zirconium, magnesium, iron in bismuth by both wet chemical and spectrographic methods. Determination of rare earth in thorium has been initiated.

Results to date indicate that sand blasting and cleaning with inhibited 5% HCL followed by treatment with 5% iodine solution in methanol provide a metal surface which is most easily wet by the bismuth alloy.

A study of Radiation Test Loop No. 1 indicates the system containment requires cooling in the event of a rise in ambient air during operation. The preliminary design of Radiation Test Loop No. 2 is progressing. Facilities for Radiation Test Loop No. 3 have been offered in the MTR. Evaluation of these facilities based on the quoted flux is in process.

Completed a sampling system suitable for use on the LMFRE. Calculations to determine the heating due to fission product decay in the off-gas system were initiated.

Checked latest reference design using the Spectral Code (P)*. Also checked the effect on the critical concentration due to such variables as bismuth and graphite cross-sections, graphite density and fuel penetration. The long range reactivity effects due to fission products and higher isotope accumulation are being re-examined in light of better information. The differential equations for the kinetic response of the LMFRE to a linear increase in reactivity have been solved and programmed.

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II. ADMINISTRATION

A. Submitted proposed subcontract with vendor covering study of continuous uranium-monitoring system, for AEC approval.

B. Submitted to AEC report BAW-1011 entitled "Liquid Metal Fuel Reactor Experiment Objectives and Design Parameters".

C. Attended meeting with Washington AEC to discuss outline of Phase I report and proposed research program.

D. Submitted for AEC approval proposed subcontract with vendor for designing, drafting and specification writing assistance in the field of mechanisms.

E. Submitted to the AEC report BAW-1012 containing an economic comparison between the breeder and burner concepts of the LMFR.

F. Submitted to AEC report on meeting at Brookhaven National Laboratory with Mr. G. W. Horsley of the United Kingdom.

G. Discussed with Brookhaven National Laboratory aspects of 4" utility test loop which relate to operation of this loop by B&W instead of BNL.

III. TEST PROGRAM PLANNING (W. R. Foley)

The Research and Development Program was completed. The Chemistry section was completed and several additional research and development items were added to the other sections. In addition, a critical experiment was included in the research and development program.

The project handbook, which is a compilation of data and constants of interest within the project, was completed and issued.

Calculations, parameters and preliminary designs of the Prototype section of the Research and Development program were discussed with Alliance personnel. Requests for bids for small isolation valves, dump valves and check valves were issued. Bids were received for large LMFRE test pumps.

A component testing schedule was discussed with Alliance and issued.

A study of the shielding requirements indicated the necessity for test data. Preliminary calculations and studies were performed to determine which in-pile loop will be utilized for the shielding experiments. A detailed test specification will be drafted for this work.

Meetings were attended at BNL and Alliance Research Center to discuss the 4" utility loop, various loop programs, and other items revelant to the LMFRE program.

IV. LMFRE PRELIMINARY DESIGN STUDIES

A. REACTOR ENGINEERING (J. J. Happell)

Work on specification drawings for the quadrant type core has been temporarily suspended due to higher priority of drawings required for the Phase I report to the AEC. Work continues on the written specification for this core arrangement.

An alternate top end reflector arrangement has been proposed and a preliminary drawing completed. The scheme utilizes a quadrant type graphite tank and a drilled block insert which is held down by key blocks and graphite screws. A natural graphite filler is proposed as a gasketing material. Cementing will be performed after all pieces have been impregnated.

The reactor group has been requested to re-evaluate the benefits of the present arrangement which specifies control rods operating in beryllium thimbles vs uncontained control rods which operate directly in the cell fluid. This will be done at the earliest opportunity and the conclusion published.

A reactor description has been completed for the Phase I Report to the AEC.

A summary of reactor cost estimating information has been submitted to the project administrator.

A detailed preliminary reactor vessel specification is being prepared.

Thermal calculations were continued during the past month. A report summarizing all previous thermal calculation results is being prepared for distribution.

Analogue study results for step inputs of reactivity without rod control have been received. This preliminary study indicates that for small reactivity additions, the LMFRE system may oscillate on a fairly long cycle period. These results indicate that (1) a servo-controlled regulating rod may be required for adequate system control, and (2) more analogue work is mandatory to more fully investigate the characteristics of the LMFRE system. A specification for additional analogue work has been prepared and submitted for vendor bids. Additional discussion of this item is included in the Instrumentation section of this report.

B. NUCLEAR ENGINEERING

Shielding calculations continued during the month to determine the gamma spectrum at the core surface, fission product activity in the various component cells, and required thickness of the reactor cell plug.

Arrangements are being made to include provisions for measuring relaxation lengths of delayed neutrons in barytes concrete in radiation loop #1 at BNL, or an equivalent installation.

Sections of the Hazards Report concerning containment and accident postulation have been completed. Work was initiated on the maintenance section of the report.

A meeting was held in Washington with members of the AEC Hazards Evaluation Staff to review our over-all containment philosophy. The proposed containment was considered quite adequate, pending a more detailed study of the Phase I and Hazards Reports which will be completed in the near future.

C. PHYSICS AND MATHEMATICS (T. C. Engelder)

1. Criticality Studies

a. The latest reference design has been run using the Spectral Code (P)*. For V(Bi)/V(C) = 0.5 and N(25)/N(Bi) = 1000×10^{-6}, the equivalent cylindrical height and diameter are 104.8cm (3.44 ft.). This value is somewhat larger than previous cases.

b. The effect on the critical concentration of the reference design due to such variables as bismuth and graphite cross-sections, graphite density, bismuth and/or fuel penetration, have been considered. Using reasonable ranges of values based on present knowledge, an allowance of about 150-200 ppm. of U^{235} must be made for these effects. Presumably this margin will be reduced as information becomes available from the Research and Development Program.

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c. Additional critical experiments have been checked where applicable. The detailed results of this study will be reported elsewhere.

d. The study of an alternate reference design employing a metal core tank wall is continuing.

2. Reactivity Effects

a. The long range reactivity effects due to fission product and higher isotope accumulation have been recalculated using better information on the relation between critical concentration and poisoning. After two years of full power operation and no fission product removal, the total uranium concentration will reach about 1475 ppm. by weight.

b. The reactivity associated with the core and reflector test holes containing either U^{235}-Bi or Th-Bi has been computed, based on the homogenization of the test hole region. This problem is being investigated further using adjoint flux calculations.

c. The various reactivities that must be controlled by rod motion have been summarized for the reference design; about 10% in k will be required.

3. Control Rods

a. Additional black and gray control rod calculations have been made using the Con-Rod II Code (P). Thermal extrapolation distances have been computed for black, tantalum, and Croloy rods. The worth of rings of four rods of tantalum and Croloy is about 30% and 20%, respectively. (The values given in BAW-1013 for Croloy and tantalum were for single rods in the ring.).

b. The reduction of control rod worth when enclosed in thimbles of beryllium or Croloy is still being investigated.

4. Kinetics

a. Additional runs have been made using the transient analysis code. The earlier observations of serious pressure and temperature excursions when reactivity is added at more than 2-3%/sec. have been confirmed. The results will be reported more fully in the Phase I Technical Report.

b. Information about the behavior of the graphite temperature, fuel velocity and temperature, gas volume and pressure in the pressurizer, and multiplication constant during a typical transient has also been obtained.

c. The differential equations for the kinetic response of the LMFRE to a linear increase in reactivity have been solved and programmed for the Electrodata computer, for use in reactor startup problems.

5. Critical Experiment

a. AEC approval of the LMFRE critical experiment as proposed in the last monthly progress statement has been withheld, pending evaluation of the results of the Phase I study. In view of the stringent time schedule, the AEC has, however, authorized the design of the remote assembly mechanism, but no materials may be purchased until complete authorization has been received.

D. INSTRUMENTATION AND CONTROL (J. P. Sluss)

Negotiation for high temperature neutron detector development was delayed until Phase II because of the necessity to complete Phase I requirements on time.

Source manufacturers were contacted regarding the availability of Sb-Be sources. It appears that Oak Ridge will be able to provide the necessary source for the LMFRE. This source can be placed within the core by utilizing a small portion of the central test hole.

Reactor startup studies were completed for various rates of rod withdrawal speed and fuel circulation times. The method outlined in WAPD-13 for the solution of the reactor equations for a ramp input of reactivity were used and a check obtained by B&W Physics and Mathematics Department, utilizing an independent numerical method for the solution of the reactor differential equations. No difficulty is expected in obtaining a perfectly safe operating procedure for the startup of the reactor.

Preliminary reactor analogue studies were completed for 20, 50 and 250 MW reactors. Sufficient runs were conducted to determine that the temperature coefficient of the reactor is insufficient to give adequate response for small step changes in reactivity. The temperature coefficients of reactivity for both the fuel and graphite were increased to determine the

stabilizing effect. Slight improvement in response was noted but the system was not self-regulating. The time delay for the graphite temperature coefficient was decreased with approximately the same results as above.

E. SYSTEMS ENGINEERING (S. S. Waldron)

A number of proposals were received from pump manufacturers for the bismuth test pumps for the 12" pump loop and the evaluation of these proposals has begun. Proposals represent a very wide range in design, delivery, and price. Proposals submitted give some indication that perhaps the time situation as to delivery is not so bad as was previously thought. A great deal of work has yet to be done before a decision as to selection can be made.

Month was taken up principally with preparation of information for Phase I report. Specifications were prepared and sent out for quotations. A rewrite of the reference design writeup was made and added sections were prepared on alternate designs. Drawings were prepared for use in the Phase I report.

F. MECHANISMS ENGINEERING (G. R. Winders)

1. Product application conferences were held with a number of companies.

2. Negotiations are continuing for the procurement of consultant services for Mechanisms Engineering. All bids were evaluated, and inspection visits were made to the facilities of the most promising bidders.

3. Detailed cost figures pertaining to operational mechanisms and remote maintenance equipment were estimated and submitted.

4. Draft write-ups were released pertaining to the remote maintenance of the LMFRE. The final write-ups will be utilized in making up the Phase I Report to the USAEC.

5. Modifications of Plant Layout No. 3 and Component Arrangement No. 13 were developed for use in the Phase I Report to the USAEC. Supplementary drawings were released showing conceptual views of a hot cell arrangement and of a maintenance plug.

6. Welding development work was discussed with personnel from the Alliance Research and Development Laboratory.

7. Development work is continuing on hot cell arrangements.

G. CHEMICAL PROCESSING (W. E. Miller)

Phase I Reference Design for the F. P. V. removal system was completed. Drafts of the chemical process sections are being issued by U. C. N. C. and B&W. These will be integrated in June for the Phase I report.

The final draft of the Chemistry Section of the LMFRE Research Program was completed.

Work was initiated on the design of a waste disposal system for the LMFRE.

A conceptual design for a sampling system suitable for use on the LMFRE was worked out.

Calculations to determine the heating due to fission product decay in the off-gas system were initiated.

The probable concentrations of uranium, protactinium and fission products, as a function of time, have been calculated for an in-pile loop circulating thorium-bismuth slurry.

On May 1, 1957 a meeting was held at Argonne National Laboratory to continue discussions of fluoride volatility processing. B&W agreed to send a letter to Argonne requesting a research proposed for a study of processing LMFR fuels by fluoride volatility methods.

V. RESEARCH AND DEVELOPMENT

A. MATERIALS TESTING

E-1316 and E-1317 Corrosion Testing Loops (W. Markert, Jr.)

The construction of four test loops for investigating the suitability of Croloy 2-1/4 for use with liquid bismuth is under way. These loops are being constructed in accordance with the general design previously tested on the utility loop. Certain modifications are being included to correct minor deficiencies noted during the initial testing of the utility loop.

Two of these loops will be fully annealed and two will be normalized and tempered. Since the loops are reasonably small in size, it is possible to construct the entire loop, with the exception of the pump, and to heat treat it as a single unit. Arrangements have been made to use large heat treating furnaces in the Barberton Works of the Babcock & Wilcox Company for this heat treatment.

The electrical components for the four test loops are being assembled. Major components such as switches, starters, transformers and Varidyne units are in place. The control circuitry and much of the instrumentation are complete.

The tests which are planned for these loops are as follows:

	5E	4A	5A	9E
Maximum Temp., F	885	885	885	975
Temp. Differential, F	135	135	135	225
Velocity, Ft/Sec	6	6	12	6
Heat Treatment	Normalized & Tempered	Annealed	Annealed	Normalized & Tempered
Additives, ppm				
Zirconium	350	350	350	350
Magnesium	350	350	350	350
Uranium	1000	1000	1000	1000
Time, Hours	1500	1500	1500	1500

E-1318 Tilting Capsule (W. Markert, Jr.)

The tilting capsule equipment is assembled and in the last month, difficulty was experienced in stabilizing the controlling equipment. It has been necessary to rewire the thermocouple system in order to reduce resistance, and to place capacitance in each Wheelco Amplitrol controller to eliminate drift, thus permitting a final setting on each controller within the desired range.

The program is now checking chemical cleaning methods by cycling capsules prepared by the Chemistry Department. Other capsules are being tested to improve techniques, procedures in loading, sealing and surface preparations while specimen weights and capsule surfaces are being noted.

A metallurgical examination has been completed on three samples of Croloy 2-1/4 tubing, involving six heat-treating variations. These treatments were run to determine the optimum heat treatment to be used in capsule tests.

E-1292 Zirconium Nitride Theory (F. Eberle and W. A. Keilbaugh)

Chemical analysis of 21 heats of Croloy 2-1/4 for: total nitrogen, acid soluble nitrogen, acid insoluble nitrogen, total aluminum, and acid soluble aluminum are completed with the exception of recheck on acid soluble aluminum results.

A carbon-free and nitrogen-free heat of Croloy 2-1/4 has been vacuum melted and forged to 1-1/2" round to be used for test purposes. It is proposed to cast a heat of carbon-free with nitrogen and nitrogen-free with carbon for capsules to check the existence of a zirconium nitride vs. zirconium carbide theory.

E-1343 Miscellaneous Material Investigations (F. Eberle)

Tests are in process on Croloy 1-1/4 and Croloy 2-1/4 tubing as received from Beaver Falls. These are short-time tensile tests at room temperature and 400, 500, 600, 700, 800, 850 (proposed operating temperature), 900, and 975 F (maximum operating temperature).

At present, tests are complete for: room temperature, 400, 500, and 600 F on Croloy 1-1/4 material only.

Orders were placed for all materials necessary to convert eight B&W type creep-rupture units for use with liquid metal. These orders were for vacuum equipment and auxiliaries and a high speed recorder from Brown Instrument Company. Orders to the shop for making the necessary changes in the creep-rupture machines and for the fabrication of test assemblies and specimens to be machined from Croloy 1-1/4 and Croloy 2-1/4 materials were also placed.

The vacuum pump has been received; otherwise, all orders are in some stage of processing.

E-1281 Chemical Analyses (W. A. Keilbaugh)

Wet Chemical Methods

Uranium - The development and testing of procedures for analyses of uranium in bismuth have been completed. This method employs a sodium carbonate separation and the addition of diaminocyclohexane tetracetic acid (DTA) to remove or complex a wide range of possible interfering ions. The yellow uranium VI dibenzoylmethane is measured by differential absorbance at 412 mu and 426 mu.

Zirconium - The chemical method, as submitted by BNL, for the determination of zirconium in bismuth has been tested in our chemical laboratory. However, it is hoped to change or provide adaptations of this method which would better lend themselves to routine analysis. Separation techniques such as ion exchange procedures and use of metal reductants have been tried. The use of zinc metal has shown the most promise for removal of bismuth though a study of the possible deleterious effects of diverse ions has not been completed.

Magnesium - The desired precision has not been obtained using wet chemical procedures for analyses of this metal in bismuth containing additives and corrosion products. Good results are obtained on pure magnesium standards, indicating that the numerous separation steps necessary for complete bismuth removal adversely affect reproducibility. Ion exchange procedures are under study and absorbance vs concentration curves have been prepared. Data on reproducibility and accuracy in use of this modification is now being obtained.

Iron - Analysis for iron in bismuth, using the very sensitive bathophenanthroline method was suspended due to the time consuming procedures necessary to assure low blanks and minimum levels of iron contamination. The Brookhaven method

for analysis of iron, which uses a dichloroethyl ether-n hexane extraction of the o-phenanthroline complex, is currently under study.

Spectrographic Methods

Zr and Mg in Bismuth

In the last progress report it was pointed out that a spectrographic method for zirconium and magnesium in bismuth had been developed, utilizing a solid oxide sample (from an evaporation of a bismuth solution) as the spectrographic sample. Although the method appeared satisfactory, it involved an additional time consuming step - that of evaporating the liquid sample to dryness, and was not readily adaptable to routine control of the bismuth loops. As a result, a solution excitation technique, similar to that used at Brookhaven was investigated. Results showed that zirconium and magnesium could be determined directly on the solution sample over a range of 100-500 ppm (with respect to bismuth). The method has been in use for the past month in determining zirconium and magnesium on samples from the utility loop as well as the tilting capsule tests.

The disadvantage of the above method lies in the limited sensitivity which is attainable, not only for the zirconium and magnesium, but also for iron and chromium. This limitation is more serious in the case of the latter two elements because of the relatively low level of concentration expected (5-20 ppm). As a result, more work is necessary in determining iron and chromium in this type of material.

Determination of Rare Earths in Thorium

It is anticipated that the thorium to be used in the thorium bismuthide slurry will require analysis for various impurity elements. Many of the rare earth elements have exceedingly high neutron capture cross sections and furthermore, are particularly difficult to determine in thorium. Anticipating the need for this analysis and realizing that the development of a method for this determination might require considerable time, work was initiated this quarter whose purpose was to develop methods which would be satisfactory for carrying out this determination.

B. PROTOTYPE TESTING

E-1337 Evaluation of Engineering Tests

A test apparatus for testing the reactor dump valve

(primarily) has been designed. Some of the requirements maintained by this design were an opening pressure head of 86 psi and a nearly constant flow velocity through the valve. Other components which may be tested in this apparatus are temperature indicators, pressure gages, flow meters, liquid level indicators and check valves.

Further work on the valve development programs will be described in the future under the appropriate E number now assigned to each project.

Members of the Research Center also participated in discussions regarding specifications and design details of several large bismuth pumps. Components and arrangements of test apparatus for the test of a full size prototype pump have been studied.

E-1288 Utility Test Loop (W. Markert, Jr.)

The utility loop has had a total operating time of 675 hours. Of this time, eight hours were with a ΔT on the circuit. The ΔT condition was not maintained any longer than necessary to check the various loop components because the additive concentrations were not known. Magnesium and zirconium have been added to the loop in both the hot and cold legs. Development of a sampling technique has been made.

A new heat exchanger with smaller clearances at the floating tube sheet was installed. A considerable portion of the bismuth flow in the original heat exchanger was leaking by the tube sheet. It is expected that the new exchanger will reduce the leakage to a tolerable amount.

E-1370 Croloy to Graphite Seal (W. Markert, Jr.)

Drawings were completed for the Croloy to graphite seal apparatus. Some of the material for testing is already on hand. Since the special steel and special grades of graphite are on a four month delivery schedule, the screening tests were revived in order to get as much preliminary work done as possible. The screening tests are about to begin operation since we were fortunate to have some old bearing testers on hand which only needed some minor alterations to adapt them to our needs. These tests will start with commercially available graphite and later tests will be conducted with the special grades planned for LMFRE.

C. CHEMICAL PROCESSING

E-1332 Fuel Reprocessing (W. A. Keilbaugh)

A tentative program has been outlined to cover the research and pilot-scale testing of the combination molten salt and fluoride volatility concept of nuclear fuel reprocessing. This program includes the estimated time, space and manpower requirements necessary if the Research Center is to undertake the project.

The program has been reviewed by Research Center personnel and has been presented as a tentative proposal to AED personnel at Lynchburg. Further discussion of the proposed program is to be held early in June.

D. INSTRUMENTATION

E-1335 Continuous Uranium Monitoring System (W. A. Keilbaugh)

Early in May 1957, a study was undertaken to determine a possible method for setting up a monitoring system which would be capable of providing a continuous uranium 235 concentration signal for both indication and control over a range of 10 to 2000 parts per million.

Specifications have stated that the uranium monitored will be in bismuth also containing approximately 500 ppm of zirconium and magnesium operating at a temperature of between 750 and 1200 F. The instrument should be capable of monitoring with an accuracy of ± 2% and respond to changes of concentration with a minimum period of delay.

An extensive library search was undertaken to determine the chemical and instrumental methods that could be applied to a project of this type. The chemical and metallurgical problems that are involved in the operation of a bismuth loop were investigated.

Methods such as x-ray, spectrographic, mass spectrometric, subcritical multiplication techniques, neutron gun methods and polar-graphic methods are being considered. Discussion with representatives of various companies and an ASTM Committee (E-14) working on similar problems, have helped in evaluation work.

This work will continue with the objective of submitting recommendations for the most suitable methods for actual development.

E. REMOTE MAINTENANCE

E-1280 Remote Welding (M. Christensen)

A limited amount of groove welding on carbon steel has been done by means of the gas-shielded metallic arc process. Application of this process to groove welding requires a more versatile positioning device to support the head. This is being planned. Several other additions to this welding arrangement are being considered each of which should improve the operation and resultant welds. Several grades of Croloy wire are on order so that we may examine the application of this process to low alloy material.

During May several welding concerns were visited in search of new processes or new equipment that would contribute to the development of remote maintenance. Evaluation of the various equipment seen at these installations is being made.

An order for a 300 KW transformer to furnish current for an indiction - forge butt welded joint has been issued. A unit to provide the necessary pressure is in the preliminary design stages.

E-1282 Chemical Cleaning and Decontamination (W. A. Keilbaugh)

All attempts to clean equipment of any size, with the method described in the preceding report, were unsuccessful. In all cases, an insoluble black film, composed mainly of alpha iron, remained on the surface, and could only be removed by mechanical scrubbing.

After continued investigation, additional cleaning methods were chosen for further evaluation.

Croloy 2-1/4 capsules were cleaned by the various methods, charged with bismuth plus 1000 ppm uranium and 300 ppm each of zirconium and magnesium. These capsules were then installed in the tilting capsule apparatus. After a week's test, the capsules are cut open and examined.

Results to date indicate that two of the first four cleaning methods provide a metal surface which is most easily wet by the bismuth alloy. These are:

1. Sand Blasting.
2. Cleaning with inhibited 5% HCl followed by treatment with 5% iodine solution in methanol.

Scrubbing the acid cleaned surface by circulating a slurry of MgO through tubular specimens, provides a very clean appearing surface, i.e., free from previously observed alpha iron deposits. Capsule tests are now being made on surfaces cleaned by this method.

It is planned to use metal surface examination by x-ray and electron diffraction as a means of correlating surface condition, as provided by various cleaning methods, and results of exposure to molten bismuth alloy in the capsule tests.

VI. RADIATION LOOP TESTING (E. E. Walsh)

A. RADIATION TEST LOOP NO. 1

A study to determine whether the system containment required cooling in the event of a rise of ambient air during operation, was completed. The results of this study indicated that cooling is required, and adequate equipment has been ordered.

Designs of the cooler and furnace have been completed. Upon approval of these designs, fabrication of these components can begin.

Final design of the Melt-Dump Tank is in process.

B. RADIATION TEST LOOP NO. 2

The preliminary design phase of this system is in process and the detailed information necessary to obtain ETR engineering approval is being compiled.

C. RADIATION TEST LOOP NO. 3

Negotiations for test space in the MTR were continued and resulted in a suggestion by MTR to consider use of either HG-5 or HR-4.

The flux in HG-5 is approximately 10^{13} and is lower in HR-4.

Details of these facilities and the floor space related to each are en-route from MTR.

Evaluation of these facilities based on the quoted flux is in process.

VII. HAZARDS EVALUATION

Sections of the Hazards Report concerning containment and accident postulation have been completed. Work was initiated on the maintenance section of the report.

A meeting was held in Washington with members of the AEC Hazards Evaluation Staff to renew our over-all containment philosophy. The proposed containment was considered quite adequate, pending a more detailed study of the Phase I and Hazards Reports which will be completed in the near future.

END