

**LIQUID METAL FUEL REACTOR
EXPERIMENT
MONTHLY PROGRESS STATEMENT**

JULY, 1957

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UNITED STATES ATOMIC ENERGY COMMISSION
BY
THE BABCOCK AND WILCOX COMPANY**

LMFRE MONTHLY PROGRESS STATEMENT
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I. SUMMARY

Specifications for the BNL 4-inch utility loop were reviewed and comments will be firmed up soon.

Croloy 2-1/4 stock for the out-pile section of BNL Radiation Loop No. 1 was shipped to Barberton on July 12. Work on the in-pile section began July 22, and a three month delivery date has been promised.

The failure of 430 valve bellows was discussed with BNL personnel. The Test Program Planning Group was reorganized and renamed the R&D Coordination Group.

Preparations were completed for a three-group, two-dimensional criticality calculation (CURE Code), using the IBM-704 computer. Preparations are being made to perform a limited number of control rod calculations using the CURE Code.

Recomputed disadvantage factors indicate that the reactor can be considered homogeneous to within one percent.

Efforts are being made to resolve a minor disagreement between the modified twenty-group Spectral Code (P)* and the completed forty-group Spectral Code. (P)*

Flux depression in core and reflector test holes was established to be greater with 1500 ppm U-235 in bismuth in the holes than with ten weight percent thorium in bismuth.

Reformulation of the generalized set of transient equations indicate the earlier results showing large pressure rises are in doubt since they occur at times when lack of a steady-state solution is important.

Authorization was received to perform a set of LMFRE critical experiments.

Text and working drawings for the LMFRE core and reflector specifications were reviewed and distributed to vendors.

The approach to the graphite R&D program was changed; larger (40-inch diameter and up) roughly machined blocks of selected graphite grades will be ordered for testing purposes.

A price estimate was received for an impervious grade graphite test sample (40-inch diameter and 32-inch length). Formal work also was received on the cost of installing facilities to impregnate graphite cylinders larger than 50-inches in diameter.

The recently issued core and reflector graphite specifications are being revised.

* Whenever it appears in this report, the information herein marked (P) is the exclusive property of the Babcock and Wilcox Company, and is disclosed in confidence for the sole use and benefit of the United States Government and any other use is strictly prohibited.

Brookhaven graphite experiments indicate that uranium appears to diffuse into bismuth impregnated graphite which could cause trouble, and that a threshold pressure below which certain graphites do not pick up any bismuth, seems likely.

Work has started on a preliminary specification for nuclear reactor instrumentation, and a detailed master project study was started.

All prototypes in the 3/4 inch test loop (valves and instruments) were issued for quotation, and one valve was requisitioned.

Nitrogen was chosen as the intermediate system cover gas.

Vacuum, tray, sparging, and packed bed type degassers were investigated and compared.

Remote maintenance schemes now being considered are the rotating maintenance plug and the overhead bridge manipulator.

Conceptual design work was started for a liquid-metal control rod, a core-sample transfer scheme, and a remotely-controlled mobile manipulator.

Fused chloride processing, fluoride volatility processing, and analytical chemistry were discussed with BNL personnel.

Remote operation and maintenance applicable to LMFRE chemical operations were discussed with Atomic International personnel at Canoga Park and Santa Susana, California.

A thorium-bismuthide processing study was started.

Two 2-1/4 Croloy loops are completely fabricated and two others are being wired while components are installed. Four additional Croloy 2-1/4 stress-relieved loops have been fabricated and four Croloy 1-1/4 loops are being built.

At present, 40 tilting capsule units have been normalized and tempered. Work is complete on Croloy 2-1/4 corrosion specimens for the first part of the capsule and dynamic loop test.

A procedure permitting the creep-rupture testing of Croloy 1-1/4 and Croloy 2-1/4 materials in liquid bismuth was devised. Fabrication will commence in August.

Emphasis in chemical analysis has been shifted to spectrographic determination of acid-insoluble aluminum in steel because of difficulties encountered.

New standard solutions were prepared containing 10 percent Bi in HNO_3 for determination of magnesium and zirconium in bismuth. Working curves for Mg and Zr are being prepared. Improved working curves were completed for high cross-section rare earths (except samarium) and one thorium sample was analyzed by this method. Testing of wet chemical procedures for analysis of chromium and manganese in bismuth is in progress. Analysis for iron, hampered by high blanks, is now proceeding at a more satisfactory pace.

The utility test loop was reconstructed and chemical cleaning methods proposed for metallurgical loops were tested for procedures. Subsequent operation of a bismuth system with a magnesium additive resulted in leakage. Modifications have been made and the loop is now being chemically cleaned prior to operation to test components.

With modified screening apparatus, dense graphite samples were found to contain leakage with a minimum contact area stress of 1000 psi and a constant bismuth pressure of 100 psi.

Dump valve test apparatus is in the drawing stage. Arrangement drawings and necessary heating and operating control designs are being completed. Negotiations with valve manufacturers were made on the basis that B&W could have Croloy 2-1/4 bellows made to fit their particular valve design.

A number of remote cutting and handling schemes for the in-pile test loop are being developed. The most promising will be mached-up. Three methods for butt welding pipe by remote control were investigated. These methods were inert gas-protected, tungsten arc with filler wire; inert gas-protected, consumable electrode; and high frequency induction, butt welding.

Radiation Loop No. 1 may not be completely fabricated by November because: (1) valves are promised for December delivery, (2) A 1000-hour pre-operational test requirement may delay pump delivery. The Scoping Report for Loop No. 2 was completed and circulated for comment. Design modification to include post-irradiation disassembly continued. A preliminary design of the Loop No. 3 system has been completed. An arrangement with all components except pumps and sampler installed in the reactor is being considered. Administrative arrangements for a 4-inch utility test loop were concluded; design and materials were considered.

A list of recommended architect-engineer firms was sent to the AEC. A study of reactor building components arrangements and maintenance schemes has been made. Erection costs received particular emphasis.

I L ADMINISTRATION

1. Received AEC clearance for certain individuals to receive classified information from Oak Ridge.
2. Agreed with AEC to fabricate out-of-pile section of BNL Radiation Loop No. 1 without formal amendment to the Prime Contract.
3. Submitted Preliminary Hazards Report to AEC.
4. Received AEC approval to proceed with LMFRE Critical Experiment within the limitation of available funds.
5. Visited potential subcontractor to discuss remote maintenance and handling subcontract.
6. Agreed that B&W would undertake responsibility for operation of BNL 4-in. Utility Test Loop after completion of its construction.
7. Arranged for meeting between Brookhaven Area Office Manager and President of B&W to discuss LMFRE financial matters.

III. R & D COORDINATION (J. P. Holliday)

A section on beryllium was added to the Project Materials Handbook and a section on the properties of helium is about ready for issue. Many of the original verifaxed graphs were redrawn and more legible copies produced. The handbook underwent other minor revisions and additions, including a new set of index sheets. Fifteen additional handbooks were issued and twenty more will be issued soon.

LMFRE components specifications were reviewed and comments sent to the cognizant engineer. Specifications for the BNL 4-in. Utility Loop are being reviewed and comments will be firmed up shortly.

Work continued on BNL Radiation Loop No. 1. Croloy 2-1/4 stock for the out-pile section was shipped to Barberton on July 12, 1957. Work on the in-pile section began on July 22, and a three month delivery date has been promised.

Representatives from BNL and the Alliance Research Center attended meetings at Great Lakes, Carbon Corporation, National Carbon Company and Graphite Specialties Corporation. Minutes of these meetings have been distributed.

Trips were made to BNL to discuss the failure of 430 valve bellows; uranium solubility in bismuth, and recent developments in graphite testing.

A search was initiated for a suitable material to contain chemical processing system fluids.

Trips were made to Alliance to discuss loop work progress and tilting autoclave test results. The graphite-to-metal seal program was also discussed and it was decided to measure weepage rates through graphite.

A recommended procedure for initiating research and development programs will soon be circulated for comments within the LMFRE Project.

The Test Program Planning Group was reorganized, separating Research and Development from Test Program Planning. The group, renamed The R&D Coordination Group, will carry out the old organization's functions, excluding the test program. A Test Program Group will be formed when needed.

IV. LMFRE PRELIMINARY DESIGN STUDIES

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

1. Reactor Statics

a) The analysis of bare U-235-graphite critical experiments at Livermore and ORNL has been completed, and a classified report has been written.

b) In-put data associated with the reference design have been assembled and preparations completed for a three-group, two-dimensional criticality calculation (CURE Code), using the IBM-704 computer.

c) Preparations are being made to perform a limited number of control rod calculations using the two-dimensional CURE Code. The information will be used to check earlier gray and black control rod calculations.

d) Disadvantage factors for the reference design have been re-computed. The results agree substantially with earlier predictions that the reactor can be considered homogeneous to within one percent.

e) A minor disagreement has been noted between the modified twenty-group Spectral Code^(P) and the completed forty-group Spectral Code^(P). This is particularly evident in the treatment of inelastic scattering in bismuth. Efforts are being made to resolve this discrepancy.

f) The thermal neutron flux distribution in the reactor, due to a neutron source at its center, has been obtained in the absence of uranium in order to specify the sensitivity of the neutron detectors for start-up.

g) The computation of the flux depression in the core and reflector test holes is continuing. It has been established that the depression is greater with 1500 ppm U-235 in bismuth in the test holes than with 10 weight percent thorium in bismuth. The flux depression (ratio of perturbed to unperturbed flux) in the central test hole is about 0.7; the values for the reflector holes will be smaller (greater depression) but these calculations have not been completed.

2. Reactor Dynamics

a) The generalized set of transient equations has been re-formulated to obtain a final steady-state solution, and to include temperature distribution in the graphite. The earlier results showing large pressure rises are in doubt since they occur at times when the lack of a steady-state solution is important.

b) The improved set of transient equations is being programmed, using a modified Milne method instead of the Runge-Kutta method previously used. This change should accelerate the calculations in spite of the additional quantities considered.

c) The parametric survey of the transient problem has been deferred until the improved code is completed. One result has been obtained; the power transient are almost doubled if the delayed neutron contribution is omitted entirely.

d) Additional refinements to the transient analysis are being considered. They include the possibility of dividing the reactor into several regions and the addition of change of state; e. g., bismuth boiling.

e) This section is participating in the recently organized Systems Analysis Group. Among other duties, the feasibility of performing systems analysis studies on the digital computer is being investigated.

3. Experimental Physics

a) Authorization has been received to perform a set of LMFRE critical experiments. The conceptual design of the experiment is almost complete, and a number of auxiliary calculations have been performed.

b) Since the MTR in-pile loop schedule has been delayed, the problem of measuring the attenuation of delayed neutrons in various shielding materials has been investigated from other approaches. A Van de Graaff accelerator appears feasible to produce 0.5 Mev neutrons of sufficient intensity, and plans for such an experiment are progressing.

c) Methods have been examined for measuring the thermal neutron absorption cross-section of large pieces of development graphite. The use of Hanford facilities for cross-section measurements is being investigated. The accuracy of diffusion length measurements on large (40-in. diameter) cylindrical pieces has also been estimated.

B. REACTOR ENGINEERING (J. J. Happell)

The text and working drawings comprising the preliminary LMFRE core and reflector specifications were reviewed and distributed to vendors and interested B&W personnel.

A report covering core thermal calculations is almost complete.

A report recommending a containment philosophy and covering maintenance hazards, permissible levels, isotope concentrations, etc., has been issued.

The graphite R&D program recently recommended by B&W was discussed with graphite vendors and the overall approach to the program was changed. It was decided that larger (40-in. diameter and larger) roughly machined blocks of selected graphite grades should be ordered for testing purposes. Other test purposes require additional small samples. Minutes of these meetings have been issued by the Test Program Planning Group.

BNL was asked to run a test to determine (1) weepage rates of bismuth through graphite and (2), if a threshold pressure actually exists below which certain graphites do not absorb bismuth. Unfavorable test results could seriously affect the present reference design philosophy.

The recently issued core and reflector graphite specifications are being revised. Some of these modifications will allow a simpler and more accurate mockup by the critical assembly; others will improve joint construction.

and reduce the probability of flow channel pluggage by using special fittings.

Brookhaven graphite experiments produced the following conclusions. (1) Uranium appears to diffuse into bismuth impregnated graphite (this could cause trouble) and (2) there appears to be a threshold pressure below which certain graphites do not pick up any bismuth. This effect may be due to bismuth surface tension which presents interesting possibilities in the design of LMFR reactors.

The design of a degasser was discussed with the Chemistry Group. This degasser would insure a minimum liquid level in the reactor outlet head at low loads and require low gas overpressure (preferably a high vacuum) in the reactor gas space. The minimum level problem appears to be solved. Reactor gas overpressure has not been set (depends upon probability of air inleakage vs. pressure).

A price estimate for an impervious grade graphite test sample (40-in. diameter x 32-in. long) was received from National Carbon Company. Formal word was received regarding time and cost of installing facilities for impregnating graphite cylinders larger than 50-inches in diameter.

The Materials Section is investigating metal alloys for possible use in a liquid-metal type control rod.

The Physics Section issued more definite information on the reference design parameters. They suggest a possible error in calculations and properties of ± 5 -inches in core diameter. They expect these errors to be reduced as more information is obtained. Assuming the maximum error and that cemented joints of 3-inch width are adequate, an overall core block diameter of approximately 52 inches would be required.

Graphite-metal joint screening tests at Alliance are still in the preliminary stage. Poor graphite grades were used in the preliminary tests to check out equipment and the results are not worthy of note. Subsequent tests using HLM graphite, a 6-inch diameter seal, 600 to 2000 psi compression, and a pressure differential of 100 psi indicated zero leakage. This information is unofficial but a formal report should be available soon.

The reference reactor layout is still in the process of refinement. Detailed stress calculations are being made and various dimensions are being fixed.

The Mechanisms Group decided to postpone work on the problem of loading and removing direct-immersion core samples from the reference core.

More pressing work has limited shielding calculation results. Calculations to size the barytes shield around the test loop in the ETR reactor have been initiated. Work continued on a machine calculation of overall canyon floor thickness. Conferences were held with the Physics Section to set parameters for the shielding loop test work. The Physics Section is now responsible for getting required shield design information.

Proposals covering system analysis for the LMFRE were received from Dian Laboratories, Electronic Associates, and Franklin Institute. A committee, composed of personnel from Systems and Components, Reactor Engineering, and the Physics-Mathematics Department, was established to outline functions necessary for expeditious handling of all system analysis.

Memos were issued in regard to monitoring leakage of primary fluid into a cell or into secondary fluid. The need for monitoring radiation levels at high temperatures was discussed. It now appears that conventional detectors can be adapted for all necessary radiation monitoring; thus eliminating the development of specialized monitors.

Work has started on a preliminary specification for the nuclear reactor instrumentation.

C. SYSTEMS ENGINEERING (S. S. Waldron)

A detailed master project schedule was started. Completion should be within the next two months.

The prototype testing research and development program was completely reviewed and scheduled. A status procedure was instituted.

All prototypes in the 3/4 inch test loop (valves and instruments) were issued for quotation. One valve was requisitioned.

Containment studies outlined in the June Monthly Progress Statement are nearing completion and reports are forthcoming.

The 4-inch Brookhaven utility loop is being completely reviewed to check their proposed operating conditions in view of possible recommendations for future operation.

The pump evaluation draft is complete and a requisition should go out the first week in August.

Leak detection of U-Bi in Na or vice versa is being studied to help establish system pressures, shielding, monitoring requirements, etc.

Nitrogen was chosen as the intermediate system cover gas.

The following type degassers were investigated and compared.

- 1) Vacuum
- 2) Tray
- 3) Sparging
- 4) Packed Bed

Primary system dump requirements are being studied.

Plant arrangement studies continued. A series of sketches on heat exchanger arrangements was made and the effects of new maintenance schemes evaluated.

D. MECHANISMS ENGINEERING (G. R. Winders)

Inspection visits were made to the following AEC facilities:

1. Savannah River Project
2. Sodium Reactor Experiment - Atomic International
3. National Reactor Testing Station
 - a) MTR, ETR, and Chemical Processing Plant - Phillips Petroleum Corporation
 - b) EBR - Argonne National Laboratory
 - c) STR - Westinghouse Corporation
 - d) ANP Remote Handling Facility - General Electric Corporation

Product application conferences were held at the following vendor's plants:

1. Borg-Warner Corporation

2. Barrett-Craven Company
3. Manning, Maxwell, and Moore Inc.

Conceptual development work has continued on proposed maintenance schemes. The rotating maintenance plug and the over-head bridge manipulator schemes are now being considered.

Some conceptual design work has been done on the following equipment:

1. A liquid-metal control rod.
2. A core-sample transfer scheme.
3. A remotely-controlled mobile manipulator.

E. CHEMICAL PROCESSING (R. D. Pierce)

1. Facilities Visited:

- a) Brookhaven National Laboratory on July 1st and 2nd to discuss fused chloride processing, particularly BNL Loop N.
- b) Brookhaven National Laboratory on July 1st and 2nd to attend analytical chemistry meeting and to discuss LMFRE analytical chemistry.
- c) Brookhaven National Laboratory to discuss fluoride volatility processing with BNL and ANL.
- d) Oak Ridge National Laboratory on July 18th and 19th to attend the Molten Salt Symposium.
- e) Atomic International, Canoga Park and Santa Susana, California on July 25th and 26th to visit the SRE and discuss remote operation and maintenance applicable to chemical operations.
- f) National Reactor Testing Station on July 29th, 30th and 31st.

Visited MTR, ETR, STR, CPP, ANP and EBR sites to discuss operation and maintenance philosophy which might aid the LMFRE chemical plant design.

2. A study of thorium-bismuthide processing was started.
3. Detailed research specifications are in preparation for following studies:
 - a) Fluoride and chloride fuel processing.
 - b) Degassing.
 - c) Analytical procedures.
 - d) Fuel make-up.
 - e) Reactor chemistry.
 - f) Corrosion in fused salt system.
4. A study of LMFRE chemical analysis requirements continued.
5. The study of adsorption of inert gases continued.
6. Phases of the chemical research program were discussed with Armour Research Institute and Syracuse University.

V. RESEARCH AND DEVELOPMENT

A. MATERIALS TESTING

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

Two of the four 2-1/4 Croloy loops under construction are completely fabricated as planned. Modifications are under way to eliminate the oil leakage described under E-1288. The final step will be chemical cleaning. The other two loops are being wired, while the water, oil piping, and the auxiliary heaters are being installed.

Four additional Croloy 2-1/4 stress-relieved loops have been fabricated. It is planned to start wiring these panel boards in the Electric Shop within the week. These test units will be completed after the new building is ready for occupancy.

Four stress-relieved Croloy 1-1/4 loops are being fabricated at present. These will be followed by four normalized and tempered Croloy 1-1/4 loops. Sufficient pipe and tubing has already been heat treated at Barberton for the latter loops.

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

Work has been completed on the required Croloy 2-1/4 corrosion specimens to facilitate the first portion of the capsule and dynamic loop test. At present, 40 capsule units have been normalized and tempered at the two levels required in the outlined heat treatment for the LMFRE program.

Tube wall surfaces and bismuth loadings from previously completed capsules are being checked by the metallurgical and chemical departments. The dry box was delivered late this month and has been assembled and leak checked. Heliarc weld equipment was installed and testing has been completed. Experimental work to date on cleaning methods and capsule loading has determined that comparable weight losses can be obtained and plans to start the program have been outlined. Plans for next month are to cycle capsules prepared as outlined. The first eighteen units would be loaded with bismuth, 1500 ppm uranium, 350 ppm magnesium, and 250 ppm zirconium, employing three metallurgical preparations and three surface conditions. Further work will then follow with additive variations as compared to metallurgical and surface preparations.

Due to cooling rate differential between "batch"-type commercial heat of Croloy 2-1/4 and small (3/4 in. x 1/2 in. x 1/8 in.), experimental, heat-treated pieces, the commercial microstructure was not reproduced exactly.

Metallurgical examination of capsules #10 and #11 (265-hr. cylinders) is complete. They were cycled 265 hours. Hot and cold ends of capsules were examined. These capsules were used to attempt a method of introducing the U-Bi alloy without contamination by oxygen. Both were found to contain appreciable amounts of oxide, however.

3. E-1343 Miscellaneous Material Investigations (F. Eberle)

A procedure has been devised which will permit the creep-rupture testing of Croloy 1-1/4 and Croloy 2-1/4 materials in liquid bismuth. The procedure consists of evacuating the liquid metal test chamber at various intervals or temperatures up to the test temperature. After obtaining a vacuum at test temperature (885 or 975 F), the chamber will be pressurized with dry helium for the duration. Progress during July was as follows:

- a) The parts for altering eight B&W-type, creep-rupture machines were completed.
- b) Half of the test assembly components have been machined and the balance will be completed in August.
- c) All materials purchased have been received except the bellows assemblies, and high-speed Brown Recorder. The bellows will be shipped the first week in August.

Fabrication of test assemblies and equipment will be under way in August.

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

a) Determination of Acid-Insoluble Aluminum in Steel

Emphasis was shifted to determining acid-insoluble aluminum because of the importance of ascertaining the various forms of aluminum in steels and the difficulty experienced with acid-soluble aluminum. It was felt the spectrographic determination of the former would be more straight forward and less subject to error. A spectrographic method was then worked out based on buffering the residue from a HCl digestion with CuO and determining the Al/Cu ratio. Results to date on two standard samples show determination of 0.007 percent Al_2O_3 vs 0.006 percent (standard value) and 0.013 percent Al_2O_3 vs 0.011 percent (standard value). To prove the method, seven more standard samples will be run in duplicate.

b) Determination of Magnesium and Zirconium in Bismuth

Our previous method was based on samples containing 20 percent Bi in the HNO_3 solution. Because it was difficult to attain such a concentrated solution, and as last month's studies showed the Mg/Bi and Zr/Bi intensity ratios depended on the strength of the solution, new standard solutions were prepared containing 10 percent Bi in HNO_3 . New working curves for Mg and Zr are being prepared.

c) Determination of Rare Earths in Thorium

Improved working curves, prepared from synthetic standard samples and corrected for continuous background, were completed this month for the high cross-section rare earths (except samarium). One thorium sample was analyzed by this method.

The testing of wet chemical procedures for analyses of chromium and manganese in bismuth is in progress. Data obtained to date is insufficient to evaluate the Brookhaven procedures for these elements. Some difficulty has been encountered in obtaining sensitivity necessary for the determination of manganese. Quantitative detection in the range of 1-10 ppm is necessary if manganese is used as an added means of determining bismuth corrosivity on Croloy steel under various test conditions.

Analysis for iron has been hampered by high blanks. These blanks, while barely tolerable, are not desirable. Early attempts at reducing blanks by synthesis of reagents or by removal of iron from reagents were not successful. Later tests, however, have given blanks values well within tolerance limits and work is now proceeding at a more satisfactory pace.

B. PROTOTYPE TESTING (W. Markert, Jr.)

1. E-1288 Utility Test Loop

The utility test loop was reconstructed and the chemical cleaning methods proposed for the metallurgical loops were tried to determine if they were satisfactory. The bismuth pump was operated during this chemical cleaning period to circulate the fluids through the system.

Following cleaning, the system was filled with bismuth with a magnesium additive and the loop placed in operation. Oil from the lower bearing was found to leak past the shaft seal and the slinger and enter the bismuth. The pump was equipped with an old-type slinger which has since been modified to prevent this leakage. A further modification is a cup which will catch oil and prevent it from contacting the hot upper surface of the pump sump where some vaporization could occur. The newer slinger design, the retaining cup and slight improvements in the oil seals should prevent a recurrence of this problem.

The loop is now being chemically cleaned and will be operated to test various components. It is planned to install a flattened two-inch section of Croloy 2-1/4 pipe in the loop at this time to accommodate an EM flowmeter test.

Examination of 1/2-inch O. D., Croloy 2-1/4 tubes from heat exchanger Run #1 is in process. This unit was in test above 750 F for 684 hours. Bismuth coating on tubes is being investigated. Both tube sheets are included in this investigation.

2. E-1370 Croloy-to-Graphite Seal

Using screening apparatus, the porosity of several grades of

commercially available graphite was found to be so great that leakage from the graphite-to-metal seal could not be determined.

A small piece of dense graphite was obtained from Great Lakes Carbon Company. The screening apparatus was revised to handle the new graphite and a test started with an initial contact stress of 2000 psi and 100 psi on the bismuth. No leakage was visible. Subsequent testing on similar graphite samples indicates the Great Lakes Carbon material can be used with a minimum contact area stress of 1000 psi and a constant bismuth pressure of 100 psi with no visible leakage.

3. E-1371 Dump Valves

One of the main valve procurement problems for this program is that thin Croloy 2-1/4 strip is not available for bellows fabrication (the bellows seal valve is the only widely used packless valve for liquid metal service). A roll of Croloy 2-1/4 (4.850 inch wide x 0.140 inch thick) was obtained and arrangements were made to reduce half of it to bellows thickness (0.014 inch). Further negotiations with valve manufacturers were made on the basis that B&W could have bellows made to fit their particular valve design, thus relieving complications involved in obtaining and engineering satisfactory bellows fabrication. Further work will be directed toward obtaining commercially available valve designs with reasonable delivery dates and prices.

Dump valve test apparatus is in the drawing stage, with the designs section completing arrangements drawings and the instrument department designing the necessary heating and operating controls. The arrangement utilizes a 16.5 foot bismuth head to provide static pressure and flow velocity through the dump valve being tested. Contamination problems from cover gas impurities are minimized, as the system will be essentially a sealed unit without helium addition or compression required during operation. A Deming pump, similar to those used on the utility loop, is used to return the bismuth to the upper tank following a dumping cycle.

C. IN-PILE WORK (W. Markert, Jr.)

E-1369 In-Pile Test Loops

The scoping report for radiation test loop No. 1 has been completed and forwarded to AED. They will in turn forward to the ETR reactor people for engineering approval. A meeting with ETR to discuss this test is planned during the month of August. A number of remote cutting and handling schemes for the in-pile test loop are being developed. It is planned to mock-up the most promising of these schemes to obtain a suitable working model for the in-pile test loop. The Electronics Section is working on an EM-type flowmeter which will be tested in the utility loop.

Preliminary design work on radiation loop No. 3 for MTR is continuing.

The proposed control and safety interlock system was studied and recommendations for overall safeguard logic was developed. This information has been turned over to the parties responsible for the instrumentation of the in-pile loop.

Developments of a suitable liquid level probe and an E. M. flow-meter are now underway.

D. CHEMICAL PROCESSING (W. A. Keilbaugh)

E-1332 Fuel Reprocessing

No activity on this project pending information from Lynchburg and the Atomic Energy Commission concerning the scope or work which B&W will undertake.

E. INSTRUMENTATION (W. A. Keilbaugh)

E-1335 Continuous Uranium Monitoring System

The library survey of possible approaches to this problem has been completed.

At present, the final draft of the report is being prepared and should be completed in the next ten days.

F. REMOTE MAINTENANCE (M. Christense)

1. E-1280 Remote Welding

Three methods for butt welding of pipe by remote control were investigated on visits to various equipment manufacturers.

a) Inert gas-protected, tungsten arc with filler wire. A summary giving test results on weld made by this process will be issued this month.

b) Inert gas-protected, consumable electrode. Further study is required to determine the technique which will produce a bead of the desired cross section and contour. To this end a correlation among the many variables must be established. These variables include wire diameter and chemistry, amperage and voltage, arc length, variation in speed of arc travel over the 360 degree fixed position weld, oscillation of electrode and angle of approach. It is probable that some synchronization of two or more of these factors is required to produce acceptable results.

c) High-frequency induction, butt welding. A 300 kw alternator, transformer, and control unit supplied by Tocco are being set up in the shop. Heavier wiring to supply the increased power demand is being installed. With this equipment the possibility of making butt welds in pipe, either by the induction forge weld process or by a fusion process, will be explored.

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

Two bismuth loops in the Nuclear Engineering Section were acid cleaned. A test section from the second loop after cleaning was found to be quite clean and essentially free from oxides of iron.

The next phase of this study will involve solution of synthetic fission and corrosion products such as would be present in an operating liquid metal fuel reactor.

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

A. RADIATION TEST LOOP NO. 1

Design of the Melt-Dump Tank was completed, and drawings were issued for comment. Several minor items are being revised before approval for construction is granted.

A drawing of the system's general arrangement has been circulated and approval is expected soon.

A sampler design is being mocked-up and is expected to be tested under simulated operating conditions within the next two weeks.

It is estimated that the in-pile section of the system will be completed in October.

It now appears that the system may not be completely fabricated by November because (1) the valves are promised for delivery in December, and (2) the necessity of a 1000 hr. pre-operational test may delay delivery of the pump. Plans are in process to circumvent or minimize these potential delays.

B. RADIATION TEST LOOP NO. 2

The scoping Report was completed and circulated for comments. Upon receipt of any comments the Report will be forwarded to ETR by August 5, 1957. A visit will then be made to ETR to discuss the technical aspects of the system and its suitability for installation in ETR.

Modification of the system design to include post-irradiation disassembly continued. Plans are in process to mock-up and test the remote cutting mechanisms necessary to accomplish disassembly upon conclusion of irradiation testing.

Evaluation of adding a degasser to the system continued.

C. RADIATION TEST LOOP NO. 3

A preliminary design of this system has been completed.

Due to the type of test facility offered in the MTR for this test and the lack of floor space, an arrangement is under consideration in which all components except pumps and sampler are installed in the reactor. When completed, this design will be forwarded to MTR for comments.

D. 4-inch UTILITY TEST LOOP

Arrangements for administration of this project were concluded and the following work started.

1. Design of the system and materials involved are being reviewed.
2. A procedure was set up for inspection and approval of materials.

**VII. BUILDINGS, GENERAL SERVICES
AND SITE DEVELOPMENT (J. D. Kenney)**

A list of recommended Architect-Engineer firms was sent to the AEC for approval. A letter of interest which includes a general description of the LMFRE, a scope of work, and a questionnaire has been drafted. A procedure which embodies the recommendations of the AEC manual has been established for evaluating the qualifications of the interested firms.

The Site Selection Report (BAW 1016) was submitted to the AEC.

Preliminary estimates, schedules, and design of an Engineering Prototype Facility were begun. This building would be used for remote maintenance mock-up and development.

A study was made of all reactor building component arrangements and maintenance schemes to evaluate their compatibility with practical construction procedures; particular emphasis was placed on erection costs.

END