FAIRCHILD ENGINE AND AIRPLANE CORPORATION

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NEPA PROJECT

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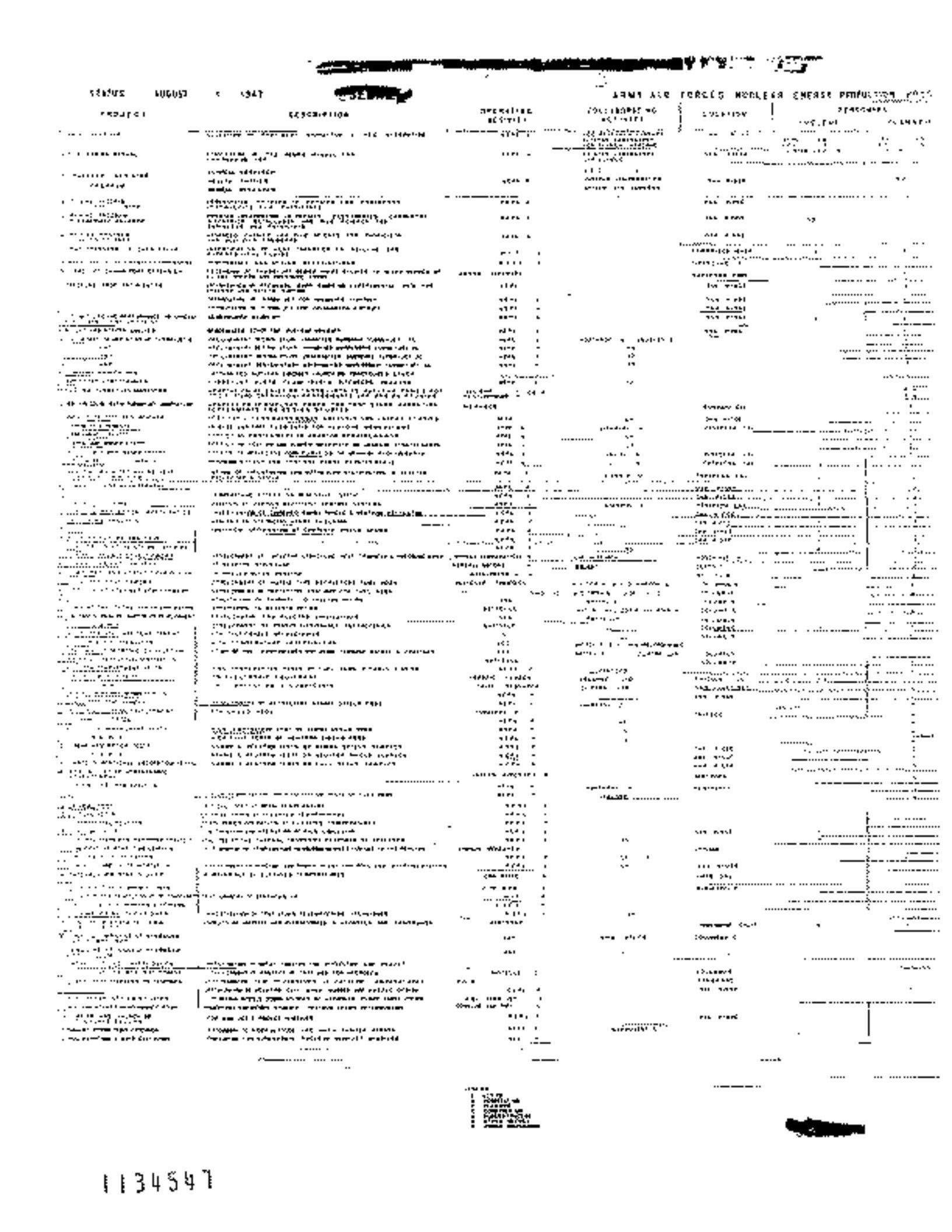

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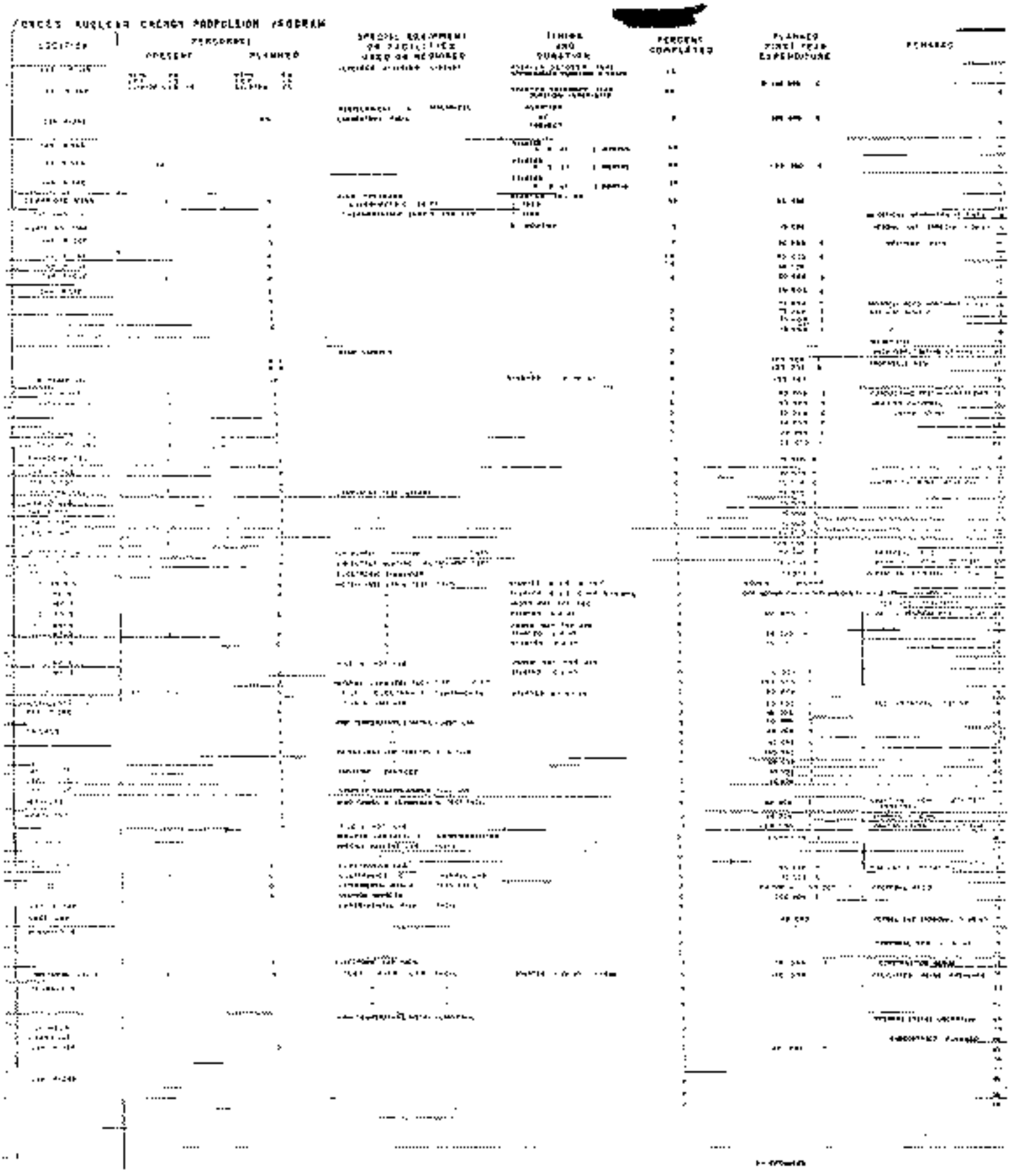

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Fig. 1

TECHNICAL INFORMATION (continued)

Education (continued)

VI. Nuclear Chemistry

A. Types of Radioactivity, Stability Rules
B. Processes of Growth and Decay
C. Induced Nuclear Reactions and Artificial Radioactivity
D. The Heavy Elements
E. Fission and Fission Product Elements
F. Natural Radioactive Elements, Missing Elements
G. Chemical Effects of Radiation I
H. Chemical Effects of Radiation II
I. Radiochemistry I, Identification of Species
J. Radiochemistry II, Carrier Technique
K. Radiochemistry III, Other Separation Processes
L. Radiochemistry IV, Systematic Quantitative Analysis
M. Applied Nuclear Chemistry
N. Chemical Aspects of Propulsion by Nuclear Energy

Instructor:

Dr. Walter J. Bleedel, University of California

A total of 166 students have enrolled for this program. An effort is being made to supplement the lectures with a tour of Clinton Laboratories.

The possibilities of organizing a NEPA sponsored heat transfer seminar are being investigated.

Project Handbook: Work has begun on the preparation of a section of the handbook entitled 'Multiplication of Neutrons', and a section entitled 'Critical Size and Mass' has been partially planned. A report, 'Estimate of Shielding Requirements for Hi-Flux Pile', has been issued.

TECHNICAL INFORMATION (continued)

Education (continued)

J. Metallurgy and technology of materials, creep strength, ductility, machinability, corrosion stress analysis, thermal stresses
K. Application of nuclear energy
L. Reactor design criteria

Instructors:

Mr. Andrew Kalitinsky, NEPA
Mr. George S. Knopf, NEPA
Mr. Richard E. Adams, NEPA
Mr. David M. Poole, NEPA
Mr. Franklin H. O'Brien, NEPA
Mr. Henry R. Kraeger, NEPA
Mr. Edward J. Foley, NEPA
Mr. Kenneth C. Cooper, NEPA
Mr. Edward S. Bettis, NEPA
Mr. J. Frank Coneybear, NEPA
Mr. Murray L. Lesser, NEPA

IV. Metallurgy

A. Review of Production Methods
B. The Metallic State
C. Principles of Phase Diagrams
D. Deformation of Metals
E. Engineering Alloys
F. Metallurgy of Pile Materials

Instructor:

Dr. Morris Kolodney, College of the City of New York

V. Survey Course in Mathematics

A. Ordinary and Partial Differential equations
B. Gamma Functions
C. Bessel Functions
D. Legendre Functions
E. Vector Analysis
    1. Divergence
    2. Curl
    3. Lapacian
F. Probability
    1. Distribution Curves

Instructor:

Dr. F. A. Ficken, University of Tennessee

TECHNICAL INFORMATION (continued)

Education (continued)

A. Survey of Atomic Physics
B. Static Properties of Nuclei
C. Relativity
D. Betatrons, Synchrotron, FM Cyclotron
E. Ion Chambers, Photographic Plate, Electroscope
F. Counters, Cloud Chambers
G. Absorption of Heavy Ions
H. Absorption of Electromagnetic waves of High Energy
I. Drop Model Theory
J. Light Nuclei
K. Cosmic Rays
L. Natural Radioactive Sources
M. Radioactive Spectra
N. Nuclear Reactions
O. Discovery of Neutrons
P. Measurement of Neutron Cross Sections
Q. Artificial Radioactivity
R. Fission
S. Theory of Alpha Emission
T. Beta Rays, Neutrinos, K. Capture
U. Emission of Gamma Rays
V. The Compound Nucleus Model of Nuclear Reactions
W. Discussion of Cross Sections and Energy Levels

Instructors:

Dr. S. De Benedetti, Clinton Laboratories
Dr. A. C. G. Mitchell, Indiana University

III. Descriptive Survey of Aircraft Engineering and Pile Application

A. Practical Aerodynamics, subsonic and supersonic
B. Aircraft design criteria, lift, drag, stability, power, landing speed
C. Aircraft performance, endurance, range, payload, speed, climb, ceiling
D. Performance limitations, power requirements, transonic stability, dynamic heating
E. Missile ballistics, mass ratio, specific impulse, aerodynamic limitations, guidance
F. Practical thermodynamics, entropy charts, power cycles, cycle limitations
G. Heat transmission, conduction, convection, radiation
H. Power plant types (turbines, turbo-jets, ram-jets, rocketal, performance criteria, efficiency, fuel consumption, specific impulse, weight, cooling, drag, cost and maintenance
I. Design criteria and limitations, pressures, temperatures, dimensions

TECHNICAL (continued)

Work has been started on the methods of separation and estimation of uranium and beryllium compounds. The reactivity of mixtures of uranium oxides and carbon is being studied at temperatures up to 2200° F.

The literature survey to determine the properties of boron, tungsten, titanium, beryllium, graphite, tantalum, and compounds has continued and should be completed during the month of August.

It is estimated that 75% of the capital items listed for present materials requirements have been contracted for or received, the remaining items consisting mainly of special equipment which will be designed and built on order. A group has been assigned to the development of this equipment.

TECHNICAL INFORMATION

Education: The summer educational program has been approximately 60% completed. A summary outline of the courses offered by this program is as follows:

I. Nuclear Science and Engineering

- A. Fundamentals of Nuclear Physics
- B. The Fission Process
- C. Neutron Diffusion
- D. Elementary Pile Theory
- E. Calculations of Nuclear Reactors
- F. Construction of Nuclear Reactors
- G. Statistical Aspects of Pile Theory
- H. Pile Kinetics
- I. Control and Operation of a Pile
- J. Basic Chemistry of the Heavy Elements
- K. The Chemistry of the Fission Process
- L. Application of Elementary Pile Theory
- M. Experimental Tests of Pile Theory

Instructors:

Professor Martin Deutsch, Massachusetts Institute of Technology
Professor Clark Goodman, Massachusetts Institute of Technology
Dr. Harry Soodak, Clinton Laboratories
Professor John W. Irvine, Massachusetts Institute of Technology
Dr. Bernard Feld, Massachusetts Institute of Technology
Mr. L. A. Ohlinger, Northrop Aircraft

II. Experimental Nuclear Physics

TECHNICAL (continued)

operation at 35,000 feet and 450, 500, and 550 mph. Several pressure ratios and a maximum wall temperature of 2500° F have been assumed.

Some preliminary design considerations have been made for a 300,000 # gross weight inhabited turbo-jet powered bomber. These design considerations include several parallel turbo-jet units, and a speed of 515 mph at 35,000 feet with 12000 # bomb load. A practical weight breakdown is being made of the above.

Pile Simulator: A control mechanism for use in conjunction with the pile simulator has been tested. This device provides a means for determining experimentally the solution of the pile equations when Ke is a function of time, and also for determining Ke as a function of time when the power level ratio is made to vary in a previously determined manner. When correction factors involving poisoning, pile expansion, etc. are fed into this computer, correct solutions of the pile equations will be obtained.

Reactor: Cooling requirements in the reflector and inner shielding of the reactor have necessitated a study of means for determining these factors.

To obtain a constant temperature diametrically across a reactor, some means of achieving a suitable pressure drop pattern must be used. It is indicated that this may best be done using variable size flow holes in the reactor proper, these holes to decrease in size radially from the reactor center line. Such an arrangement would offer the most ideal pressure drop pattern.

Studies of the problems involved in 'floating' the reactor proper have continued. Restraining springs, metal expansion mountings and hydraulic methods are being considered for application.

A layout of a test chamber in which reactor material test samples may be heated and quenched nears completion. Instrumentation requirements have been listed and sketched for this test rig.

Experimental Physics: An experimental physics program, emphasizing critical experimentation, has been discussed with Dr. Baker of Cornell University. The essentials of this program have been outlined.

Materials: Test equipment is being designed to determine material properties at temperatures up to 3000° F. The properties include vapor pressure, emissivity, thermal conductivity, thermal shock, coefficient of expansion, stability, creep and rupture, and modulus of rupture.

SUBCONTRACTS (continued)

type refractory fuel rods, has been activated by Battelle Memorial Institute. The Battelle Program will involve studies relating to the fabrication of fuel rods by suitable techniques to establish methods of obtaining high densities and high strength of beryllium in test shapes.

(f) Project No. 43 (Fig. 1), the development of protective coatings for fuel rods, will be activated August 1, 1947 by Ohio State Research Foundation.

TECHNICAL

General: The preparation of data for inclusion in NEPA Technical Report No. 5 has begun. This report will concern the materials phase of the NEPA Research and Development Program. It is planned to distribute this report during the month of September.

Reactivity: Cross-section data have been compiled and plotted for uranium, uranium oxide, carbon, beryllium, beryllia, and oxygen. Computations have been completed for uranium carbon mixtures, and beryllia computations are in process.

An investigation of the thermal broadening of resonance bands and its effects on reactivity is under way.

Shielding: A theoretical analysis of gamma-ray shielding requirements has been made. This analysis considers the effects of scattered beams. A heavy element was investigated as a shield so that the photoelectric effect was important. Specific equations were derived for the absorption of 3 Mev gamma photons in tungsten. The above analysis is being extended to include a finite volume source, and calculations are being made to determine the required rate of energy dissipation due to gamma absorption in the shield.

Heat Transfer: A comparative study has been made of the methods of evaluating pressure drop, considering both uniform and non-uniform heat fluxes. This comparison indicates a variation of only .5% between the values derived from two stepwise methods and those from an overall calculation using mean values.

Thermal Stress: Stress analysis has continued for tubular reactor elements. A four foot (diameter) graphite reactor, consisting of stacked hollow elements with interspersed moderator has been considered. It is indicated that maximum tensile stresses occur at the inner radius of the elements.

Turbo-Jet: An investigation has been initiated to determine the maximum thrust per square foot of free flow area for turbo-jet

LIAISON (continued)

A conference was held with representatives of the Radio Corporation of America Laboratories and Victor Division, to determine the extent of RCA's activity in the development of neutron detectors suitable for use by NEPA Project. A preliminary proposal is to be submitted by RCA Laboratories.

Cornell Aero Laboratory was visited and it was indicated that this laboratory will be well equipped to do shop and development work on specialized problems.

Bausch and Lomb Scientific Bureau was visited in reference to proposed dilatometer equipment. It was agreed that upon receipt of a formal request, Bausch and Lomb would undertake the design of an optical system meeting NEPA specifications. Additional dilatometer proposals have been discussed with Eastman Kodak Company, Hawkeye Division.

Harper Electric Furnace Company representatives were consulted concerning the design of special high temperature furnaces. NEPA may obtain an inverted pit type furnace from this source.

Vacuum coating and sublimation of metals and salts were discussed with Distillation Products, Incorporated. An order for vacuum coating equipment may be placed with this company.

SUBCONTRACTS

Subcontract activities during this period consisted of the following:

(a) Specifications have been written for a subcontract involving the determination of temperature and stress distribution in a drilled block type reactor.

(b) The gamma and neutron shadow shielding program has been discussed with Northrop Aircraft personnel. Optimum shielding geometry will be determined by preliminary analytical studies and a proposal will be submitted for experimental work.

(c) A conference with representatives of Fansteel indicated that the initial efforts of this company in performance of its subcontract would involve the study of the addition of refractory elements to suitably fabricated beryllia rods.

(d) A proposal has been submitted to C. M. Gianinni and Company, Incorporated, for a reactivity subcontract.

(e) Project No. 42 (Fig. 1), the development of matrix

GENERAL

Facilities: NEPA Division now occupies 12,646 square feet of floor space and requires an additional 48,854 square feet immediately, to enable machine shop and laboratory operations to proceed. Seventy-five per cent of materials capital equipment items required have been contracted for or received to date, and use of these is not possible until the above space requirements are met.

Personnel: NEPA employment totals 234 at present. Personnel procurement continues to be a matter of concern. Only 17 requisitions for technical personnel have been filled during the past month.

NEPA now has 93 employees with technical functions, 141 non-technical.

Financial: Project expenditures to date total $869,889.68. Total expenditures for July, 1947 were $115,338.43, of which $1,823.30 were subcontracting costs.

Orders have been placed for technical items in the amount of $141,300.00. Receipts against these orders total $56,400.00.

Current financial records of NEPA Division have been completed through June 30, 1947, and financial statements as of that date have been issued.

Security: Fourteen additional NEPA interim clearances have been obtained during the past month. The necessity of expediting personnel security clearances is evidenced by the fact that lack of such is delaying personnel procurement and has a direct bearing on the progress of the project.

LIAISON

NEPA Board of Consultants Meeting was held July 2, 1947 in Washington, D. C. Present were representatives of the Army Air Forces, U. S. Navy, Atomic Energy Commission, Participating Companies, and NEPA. The main subject of discussion was NEPA Technical Report No. 4. The minutes of this meeting have been transcribed and will be distributed in the near future.

The facilities of NEPA Division were inspected July 21 by representatives of the Military Liaison Committee; the Research and Engineering Division, Headquarters AAF; Office of the Assistant Secretary of War for Air; the Military Applications Committee of The Atomic Energy Commission; and Headquarters, Air Materiel Command, Power Plant Laboratory.

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NEPA PROJECT

Progress Report for the Period of
July 1 through 31, 1947

Submitted By:
NEPA DIVISION
Fairchild Engine & Airplane Corporation

J. Kaufman
Assistant General Manager

Approved:

Ronald L. Grant Major AC
Contracting Officer

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