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Richland, Washington
February 9, 1950

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16 Pages No. 1

A HISTORY OF STARTUP AND OPERATIONS OF TEE

234-5 FACILITY DURING THE YEAR 1949

The attached report covers the history of the startup and initial operation of the 234-5 facility during the year 1949.

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I. INTRODUCTION

It is desired at this time to present in summary form a factual history of the Building 234-5 operations, encompassing not only the immediate pre-start-up period from April to July, 1949, but including the major obstacles encountered in the succeeding interval to the end of 1949. This report is intended to serve not only as a review of 234-5 operations during this period but also as a documentary evidence of the difficulties experienced and the manner in which they impeded the start-up.

This report presupposes a certain familiarity with the background of the 234-5 Building. To one unacquainted with the scope of this project, or for those desiring a background review, reference should be made to Document HM-253, "234-5 Building Program Review", by D. D. Streid, dated April 22, 1949.

It must be realized that any attempt to discuss in detail all the circumstances and difficulties contributing to the start-up period would be disconcerting to the reader, and would very likely be repetitive. Therefore, although it is far from the writer's intent that a cursory review will suffice, the presentation will be as nearly as practicable chronological and comparative. For the sake of clarity it will be necessary to present several items topically.

II. SUMMARY

Responsibility for the operation of the 234-5 Building was transferred from the Technical Divisions and vested in the S Division as of April 1, 1949. At this time, three months later than the originally intended start-up date, construction of the process area was less than 70 percent complete, ventilation in the building was not ready for balancing and electrical workers were on strike. Even with repeatedly deferred deadlines, construction forces were unable to complete their prescribed work, and it was necessary for General Electric Mechanical Divisions personnel to take over completion of the work. Lack of thorough checking of equipment installation during earlier phases inflicted a severe penalty upon operating forces through the lack of familiarity with equipment, and through numerous equipment failures which may scarcely be attributed to anything other than faulty installation. Repeated failure of, and imperfections in much of the special equipment installed, not only further deferred the actual start-up of operations, but seriously impeded the personnel training program.

Accordingly, then, on July 5, 1949, with a training program not fully complete, with equipment, which by observation and trial could hardly have been considered as functioning satisfactorily, with an operating procedure lacking in detail in several respects, operations in the 234-5 Building were started at 11:10 P. M. by the transfer of a sample can of process material from the storage vault to Hood 3 in the Rubber Glove Line. The history of the building since that time has been one of almost continuous mechanical and process difficulties which, at times, completely precluded any operating activity and demanded the attention and efforts of all personnel. Frequent and repeated revisions of operating schedules were made, but none of the schedules were met. Finally, late in November, the decision was made to forgo production commitments for December so that full

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attention could be given to resolving certain very serious process difficulties and to the making of preparations for production of a new model.

III. DISCUSSION

The majority of attention during April, 1949, was focused on the completion of work by construction forces; testing and flushing of building piping, including the waste system; preparation and installation of certain specialized equipment by the Mechanical Divisions, and acceptance inspections of certain service phases and building accoutrements.

Although revised schedules for construction completion had been made from time to time, and several alternatives for acceptance had been documented in a letter to R. S. Zell from L. S. Grogan in April, establishing April 29 as a final date for work in the process area, and May 6 in the building, it was necessary to extend both dates for such items as hood testing, refrigerator hook-up, and installation of product transfer line troughs, transfer line to loading hood, and dampers in loading hood ventilation ducts. It was necessary, therefore, to have work orders for this remaining work issued by the Construction Division, thereby involving added time and effort in addition to introducing further inefficiency by assigning the work to different personnel.

In the testing of tantalum lines to the Recovery Section, several leaks were found in welds, thus necessitating removal of these lines and return to the vendor for repairs. This piping was returned and re-installed during the month. Numerous subsequent difficulties were yet to be experienced with tantalum lines.

After several attempts to wind successfully an aluminum core with tungsten heating elements for the casting hood furnaces, it was determined that the brittleness of the tungsten wire made it impossible to bend the wire to the inside of the core for the electrical leads; therefore, molybdenum wire was obtained for making of leads to the heating coils.

An inspection of the evaporator in one Recovery Hood disclosed the glass liner broken at the body flange. This, an isolated instance at the time, proved to be only a forerunner of considerable difficulty experienced with glass-lined equipment; details on subsequent failures are included in later sections of this report.

Several preliminary and intended final acceptance inspections were made on such items as the sanitary tile field, septic tank, locker rooms, ship-ping room and vaults, servicing division rooms, gate house, guard towers, steam lines, gas cylinder storage area, and waste facilities. Due to the great number of exceptions it was not possible to complete any appreciable percentage of this work. Considerable man hours were expended, nevertheless, in order to make these inspections.

The foregoing has presented a brief picture of the items in which operations were involved in April, 1949. It is the writer's intent, now, to summarize each subsequent month's activities, and then include topical presentations covering major problems.

May, 1949

Inspections of various phases of the construction work were continued during

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the month with exceptions to final acceptance remaining frequent.

Ventilation balancing efforts were accelerated on May 19 by the adoption of a 24 hour work day. This work had been delayed by the repairs necessary to numerous damaged dampers, and by a sympathy walk-out of sheet metal workers during the month. One supply fan, No. 4, was found defective, requiring factory repair, while one exhaust turbine, No. 9, was found with a secured shaft necessitating repair.

Overload circuit breakers for fans and dampers were found too small for normal operating loads; thus, replacements were ordered. Those, when received, were likewise found to be inadequate, necessitating a third order. In the interim the second lot was altered for temporary use.

In the purification hoods it was necessary to remove tantalum piping for cleaning with hydrochloric acid. This cleaning was to have been effected by the fabricator, but the piping was found to contain much scale and foreign material.

While doing this work it was noted that the Pyrex glass reactor vessels in each purification hood were cracked near the top rim; the spare reactor was also found similarly cracked. This was attributed to the possibility of head gaskets being too hard; replacement reactors were ordered at once. A similar condition was then found to exist when inspection of the super-natant hold-up tanks revealed the glass linings fractured at the lip. These were returned to the vendor for relining and were ready for shipment on May 26. At that time no General Electric inspector was on hand.

In both purification and recovery hood process line checking, leaks in tantalum lines were found. Six of these leaks were in "T" sections at welds. This piping was returned to the vendor for repair, tantalum welding facilities not being available on the plant at this time.

Preliminary tests during the month on dry chemistry hood furnaces indicated a definite tendency for water to back up or otherwise enter the furnaces. It was decided that check valves might be used to remedy this condition, and such valves were ordered, to be delivered late in June. This problem is one which will be discussed in detail in a later section of the report.

Recovery section testing of equipment was also delayed due to the installation of a replacement evaporator, installation of vacuum line scrubbers, and numerous difficulties being encountered in attempted run-ins of the Pulsafeeder pumps, due, partially, to the fact that no one working on the pumps was familiar with the operation of this type of pump.

In testing the reduction furnace electrical equipment, the vacuum pump starter coil failed repeatedly. Investigation revealed that the coil supplied would not meet the requirements; accordingly, it was necessary to order a replacement.

The problem of sealing the thermocouple wells into the castin; furnace bottoms became another item of unusual difficulty. Drawings indicated a weld, but since no tantalum welding facilities were available at Hanford, the alternatives were to substitute stainless steel wells or attempt a silver solder seal. After considerable time was spent investigating this problem, and after several unsuccessful attempts to complete the welds, it

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was decided to return the wells to the vendor for remodeling in order to incorporate a flanged fitting.

June, 1949

During June, balancing of the ventilation system was begun, was thought after some two and one-half weeks to be "nearly complete," and then was found to be a problem of such magnitude as to require the constant attention of three men per shift with little hope of any quick completion. Tests near month end indicated the necessity for temporary air locks at both main building entrances, the system having proved so sensitive. It was decided at month end to proceed with building start-up without awaiting further balancing, and to continue the balancing program on a long range basis. Major items included in the corrective program were redesign and reinstallation of the Zone 3 gravity dampers, installation of baffles in the supply plenum, installation of skirts on the gravity damper rain caps, and installation of a new atmospheric reference plenum.

Once more, time was consumed with inspections which proved fruitless. Early in the month construction requested inspection of the exhaust fans for leakage. So many leaks were found in two of three fans inspected that further inspection was deferred until the fans were ready. This work required another month, after which time provisions to prevent reverse rotation of the fans had still not been completed.

Waste disposal tanks were calibrated with water during the month; the high cost estimate for emptying these tanks by pumping delayed this work, and siphons were finally used with operations personnel performing the work.

In the laboratory section, eight sink traps developed leaks within the month after acceptance. Subsequent inspections disclosed the use of packing which was not in accordance with specifications.

Also, most of the piping connections piercing the rear walls of the purification hoods near the floor level were found to be not water-tight. In some instances the bolt holes had been elongated by construction forces to such an extent that a seal was impossible. Many of these slots had to be filled by welding, while the use of teflon (Koroseal) washers under bolt heads was also necessary.

Two more failures of tantalum tees occurred during the month, bringing the total to eight and making necessary the substitution of fluorethene tees while the tantalum was returned to the vendor for repair.

Replacement glass-lined supernate hold-up tanks were received and installed in the purification hoods, and stand-in runs begun as a test of equipment and means of operator training. During these trials two undersized transfers of "process" material occurred, one due to excessive air pressure overcoming vacuum, and the other due to air sparging plus manipulation of valves. Accordingly, air pressures were lowered, and air sparging of the supernatant hold-up tank abandoned in favor of vacuum sparging.

The Rubber Glove Line hoods, having solid stainless steel rear panels, allowed little chance for minor maintenance work without removal of the panels. Therefore, lucite replacement panels with access ports were fabricated and installed.

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It is worthy of note here that this item has contributed much to the efficiency and Safety of the many repairs subsequently found necessary.

Continual difficulty was experienced with water suck back from the dry chemistry furnace exhaust jets; this item, however, has been a constant source of difficulty and will be covered separately in a later section of this report.

The Electrical Division experienced considerable difficulty in obtaining a coil satisfactory for obtaining the desired operating conditions in the reduction hood, while using a stainless steel reactor. Outside advice plus several weeks of experimentation, however, finally aided in producing a satisfactory coil.

In the recovery section hoods, testing of equipment was delayed awaiting parts for the Pulsafloeder pumps. These were received, the pumps assembled, and lines for bleeding air plus lines for draining oil from the diaphragm compression chamber were installed. These alterations were necessary in order to obviate the necessity of entering the hoods to perform the operations.

The final pieces of tantalum tubing, one having been returned to the vendor for repair and the other a new order, were received. The latter pieces would not fit properly, however, thus, stainless steel had to remain in service.

Finally, late in the month, several water and acid runs were processed. During these, two unusual incidents occurred, one of which was directly attributable to an operating error, but both of which were significant as forerunners of subsequent difficulties which finally proved inadequate design. The difficulty experienced was during the cooling following an evaporation when caustic from the scrubber system was drawn over into the evaporator. This difficulty was later experienced several times during operations; the cause, lack of a positive evaporator vent, was not rectified until late November due to the problems and other factors involved.

The principal efforts in Part II of process area were centered in the work on the casting and coating hoods. In both instances it was discovered that much of the work performed by subcontractor electricians had been done incorrectly, incompletely, or had been omitted. This included improper wiring of Roto-sight switches, safety interlock contactors, vacuum pump contactors, lack of switch button bulbs, and faulty wiring of diffusion pump and Pirani gauge panel controls; from three to four weeks were required to correct these conditions.

The other major source of difficulty at these hoods lay in the high vacuum systems. Innumerable leaks were evident but their detection and isolation was hindered by lack of adequate leak testing apparatus, and for a time by the lack of adequate ventilation. At month end the highest vacuum obtained in a Hood 14 furnace was 1.5×10^{-5} mm of mercury, while in Hoods 25 and 26 no better than 5×10^{-4} mm of mercury had been obtained.

In checking balance operation in Hoods 16 and 24 it was noted that balance pointers could not be observed without parallax due to the dividing strip between the lucite hood windows. Since the design had provided no clearance for the balances it was necessary to install small round lucite windows in the four-inch strips.

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One further delaying item was encountered during checking of the hydraulic press vacuum system. After repeated attempts to obtain desired operating conditions failed, the Hi-Vac pump was removed and the flutter valves found not seating properly. Hard-lapping of these parts was necessary in order to rectify this condition.

July, 1949

Processing in the buildings was begun during this month; the official start-up being considered approximately 11:00 P. M., July 5, at which time a sample can of process material was removed from the storage vault and placed in Hood 3. Considerable operating and mechanical difficulties were encountered during the month wholly precluding execution of the production schedule forecast. These difficulties were to the dismay of many, but to the surprise of none in the operating organization in view of circumstances preceding the start-up as well as the design weaknesses uncovered.

Purification time cycles were approximately twice as long as anticipated; two instances of contamination of purification equipment with caustic from the purification off-gas scrubbers occurred; continuous maintenance of the hydrogen fluoride rotometers was necessary; conditioning of high vacuum equipment required constant attention and was still not completed, and the necessity for wearing assault masks in Zone 3 of Building 234 became apparent during the first week of operation.

The prime factor contributing to the delays in the time cycles is the rapidity with which the heavy oxalate precipitate settles from a slurry. This is a delaying factor in the Reactor to transfer Flask transfers as the Reactor agitator paddle does not reach the level of the slurry being transferred, and at the boat loading station where no agitation was provided. Accordingly, it was decided in July that redesign of both locations and subsequent installation of revised equipment to eliminate this difficulty should be expedited.

August, 1949

One of the foremost problems of the month was the frequent failure of the purification and recovery hood vacuum transfer systems due to plugging of filters. These failures necessitated near-continuous maintenance during the month and seriously handicapped operations. De-entrainment chambers to eliminate this difficulty were designed, and installation was begun at month-end.

Again the hydrogen fluoride rotometers required continuous maintenance. All HF lines were steam traced and lagged in an effort to reduce the presence of moisture in the gas, this work being completed near month-end.

Pressing operations were inaugurated during the month with five pieces being processed. Three of these were rejected and recycled due to defects including surface nicks, excessive oxidation, and dimensions bordering on the minimum specifications. Coupled with these difficulties, parts of two male dies were cracked due to faulty alignment of the press can, heater nest, transite base plate, and hood base plate. Correction of this condition plus reducing of the press speed from seventeen to one-fourth inches per minute consumed additional time and precluded further operation in Part II.

In the coating section, leak repairing on the high vacuum systems was continued

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with success on only one hood. One piece, although a known reject, was coated successfully.

Contamination in Zone 3 of Building 234 became an even greater problem due to maintenance on the purification hood vacuum system, valve packing leaks, and flange leaks. It was necessary on several occasions to suspend completely purification operations and devote all efforts to decontamination work. Due to this highly undesirable feature and the fact that full time respiratory protection was required, design of a glass enclosed "greenhouse" for Zone 3 was begun. This design was completed and approved almost coincident with year-end.

September, 1949

New problems arose and others continued during September to preclude attainment of the production schedule forecast.

Due to failure of the stainless steel instrument lines of the purification hoods it was necessary to replace the section of the weight factor line from the hood wall to the soffit plate with Saran tubing, and to blank the specific gravity lines at the inside flange of the hood wall. The specific gravity lines were not required for process control.

Installation of the caustic de-entrainment chambers was continued but much operating time was still lost in the several hoods prior to the installations.

One section of the dry chemistry hood failed, necessitating replacement; the glass lined lid of a recovery evaporator also failed, and one recovery hood caustic scrubber system plugged, necessitating shut-down of the hood and a special flush to clear the system.

In Building 235 there were seven failures of the casting furnace coils, and several mechanical failures of coating hood tripod mechanisms.

Contamination in Zone 3 of Building 234 remained a problem, particularly with an incident of widespread contamination from the leaks in instrument lines as described above. This contamination was spread to the corridors and locker rooms thus creating a most undesirable condition and necessitating unrelenting efforts to return the non-operating areas to their normal contamination-free status.

One other incident occurred, this time in Zone 2 of Building 234, when a ruptured hood glove was not detected in time and contamination was spread to other hood gloves, tables, run books, stairways, and the adjoining corridor. This contamination was completely cleaned and steps taken to put into effect a much more strict procedure for hand surveys following work in any hood gloves.

October, 1949

Glass-lined equipment failure again occurred during October when the recovery fume system glass-lined side arm corroded through, necessitating replacement of the entire lower section of the scrubber and realignment of the equipment.

Installation of caustic de-entrainment chambers in the remaining purification and recovery hoods was completed, thus eliminating one of the outstanding

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difficulties experienced since start-up.

Delay in production through dry chemistry occurred late in the month with an epidemic failure of the nickel screws used at that point. Replacement screws, on order, were expedited but not received until November.

One purification hood was shut down for more than a week following an operating error in which a major portion of a batch was transferred from the reactor to the Filter Head Tank which, at that time, contained the supernate and first two washes. Recycling within the hood plus processing of the supernate filter paper recovered approximately 30 percent of the batch; accordingly, a special flush was required tying up this hood and one recovery hood for four days. During recovery processing the concentrate was contaminated with caustic from the fume scrubber system, thus necessitating further processing and delay.

In dry chemistry, four of the seven furnaces were inoperable part of the time, due to weld leaks, rotometer difficulties, and plugged gas feed lines.

In Building 235, satisfactory vacuum was still not attained in one coating hood despite continued efforts on the part of personnel testing for leaks. In the other coating hood, repeated mechanical failures of a tripod assembly contributed to delays and interruptions in an operation which was functioning successfully only one-third of the time.

The problem of contamination was once more centered in Zone 3 of Building 234 with three major instances of contamination spread occurring. Two of these followed necessary maintenance work while the third, and most serious, was attributed to the collapse of a damper in the fresh air supply. This condition was alleviated and measures instituted to prevent similar recurrences in other locations.

November, 1949

In November, several of the existing difficulties continued but were modified by new developments. Principal items were spread of contamination to a greater extent and of a greater magnitude than ever before, and a deterioration in the coating equipment of Building 235 attributed to an inadvertent admixture of air with the coating gas.

The hydrogen fluoride system continued to present difficulty also, particularly with continued etching of the glass purge air rotometers. This followed closely after discontinuance of the use of purge air during hydrofluorination, a process improvement, and was attributed to failure of the valves provided. As a temporary measure copper replacements for the rotometers were installed and special gauges calibrated to permit desired gas flow.

Product solution having been drawn into a purification hood transfer vacuum line, and thence through the caustic scrubber drain to the waste sump, a special tank was installed for collection, and retention pending sample analysis, of the effluent from all purification hood caustic scrubbers.

Leakage through a defective valve included in this installation, however, produced extremely high level, widespread product contamination which required more than two weeks of continuous cleaning effort. This led to the application, on the floor and process piping in Zone 3, of 3. 2. Cocoon, a plastic strippable material which greatly facilitates subsequent decontamination efforts.

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In Building 235, operations proceeded with more success than heretofore, but more than two week's lost time resulted from reassembly and testing of the gas piping of one coating hood following the detonation; a great deal of this time was consumed, not by checking for leaks, but by repairing the leak detector. It was also necessary to procure an additional ball jar and fabricate a special grooved flange to accommodate it, a seal being effected by the use of apiezon wax.

This being the first month in which several pieces were available for final mating, it was soon determined that critical surface deformations were the prime source of difficulty. Corrective action, in the cleaning operation, was instituted, but during zealous efforts to mate material on hand, failure of the coating on three charges resulted.

December, 1949

The facility was relieved of production commitments during December in order to make certain necessary repairs, and to prepare for the production of a new model.

Processing through purification was improved during the periods of operation, but concern over product accountability necessitated shutdown of two different hoods to permit special flushes. Product was found, as expected, in the filter head tanks, supernatant hold-up tanks, transfer flasks, filter papers, and vacuum transfer lines.

Three failures of glass-lined equipment, a recovery evaporator lid, recovery fume column "T", and a purification supernatant hold-up tank, occurred. Replacements were completed in the first two instances, but the magnitude of repair work in the case of the third failure plus the spread of contamination therefrom necessitated extensive and time-consuming preparations.

Calibration of dics for the new model became an increasingly controversial subject during the period. Many theories were advanced, tests made, and steps taken to replace the dics with a new set. This latter action was delayed, however, when it was determined that no improvement in the matter at hand could be effected by such action. The dics were used, and although pieces produced were bordering on minimum specifications and were difficult to unload, sufficient service was performed to permit more careful analysis of the problem at hand before further corrective action is taken.

There was only one major instance of gross spread of contamination during the month, this occurring in the Zone 3 section of Building 234 at the time of failure of the purification supernatant hold-up tank as mentioned above. Decontamination efforts were appreciably accelerated due to the previous application of G. E. Cocoon on the floor area.

IV. TOPICAL REVIEW

In order that the principal difficulties experienced may be more clearly stated and review thereof facilitated, this topical presentation is included. The subjects are grouped under process, mechanical, and special hazards. It must be realized that these problems by no means constitute all of the difficulties encountered; they are, however, largely those problems which persisted or recurred sufficiently enough to deter markedly the expected progress of operations.

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A. Process1) Oxide Weights

The weight of plutonium oxide powder being a focal point for checking the material balance of batches processed through purification, discrepancies from normal anticipated batch weights created a source of considerable concern. Individual batch weights varied without pattern or regularity, both above and below normal, but were recognized early as presenting indications of a cumulative loss unless the equipment wherein normal hold-ups occur was flushed, and filter papers removed from equipment were processed periodically for recovery of the product.

The seriousness of this problem was accentuated as early as August when an apparent loss of some 60 units of product from one batch caused sufficient concern to have an investigation; three recurrences in September, plus continued discrepancies in October served to lessen the immediate concern while simultaneously indicating that the problem was inherent to the process. This stand was supported by the fact that over-all material balances after periodic equipment clean-outs accounted for the missing product.

The problem as a whole has not been eliminated, but the installation of traps at strategic points in the system plus the assignment of specific transfer vessels to individual hoods has aided materially in lessening the concern for such apparent losses.

2) Wastes

Concern over liquid waste losses was first evidenced in September when sump tank analyses indicated the loss of several grams of product in one lot. High and erratic losses were still indicated in October and culminated with an indicated loss of nearly 17 grams of product in one lot early in November. Steps had been taken during this time to make the changes necessary to permit retention of wastes pending analysis. It is very definitely felt that the indicated losses were for the most part far in excess of actual. The new means for permitting checking of analyses and/or resampling was instituted in November.

It is worthy of note too, that operating technique in handling wastes and in sampling also required close attention and modification. This having been accomplished also has added greatly in an indicated return to normalcy in the waste handling.

A detailed review of the waste problem is presented in Document HW-15413, "Building 234-5 Liquid Wastes" dated December 2, 1949.

B. Mechanical

It must be remembered that the majority of the difficulties described here were not known until subsequent to start-up repairs necessary, therefore, required very considerable time and were many times more delaying as they would have been during testing due to the serious contamination problems.

1) Transfer Vacuum Systems

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The vacuum system provided for process transfers in the purification and recovery hoods became a near-continuous maintenance problem within a month following the inception of operations. This was due to plugging of the packed spool pieces and assault mask canister packs by caustic vapors and dried entrained caustic. This difficulty was largely eliminated during September and early October with the installation of caustic de-entrainment chambers.

That the transfer vacuum system was still presenting obstacles was evidenced during subsequent investigations of product accountability problems when considerable product was found in the transfer vacuum lines and vacuum system caustic scrubbers. In order to remedy this condition traps were installed in the Reactor-Transfer Flask vacuum line, and the outlets from all purification hood caustic scrubbers were manifolded to a storage vessel providing retention ponding analysis.

2) HF Rotometers

The rotometers used to measure the flow of hydrogen fluoride gas in the dry chemistry section gave indication of becoming a maintenance problem the first week they were used, some three weeks prior to start-up, in June, 1949. The tendency of the rotors to stick at the top or bottom of the tube was noted, and even then it was necessary to dismantle one rotometer in order to effect repairs. With the inception of operations in July, the problem of keeping the rotometers functioning became another one of continuous maintenance. The difficulty was attributed primarily to the presence of condensation in the HF lines; accordingly, steam tracing and lagging of all HF lines, requested by operations during construction but deemed unnecessary, was begun. This required several weeks for completion, once again depriving other problems of manpower.

This action effected relief from the problem at hand and it was not until a change in procedure was effected in November that the problem of HF corrosion at this location again became serious. Coupled with the HF system is a purge air system designed to prevent entry of HF gas into other lines. Originally, a flow of purge air was maintained during hydrofluorination but this was eliminated on the advice of the Technical Divisions in order to obtain better conversions of the plutonium oxide to fluoride. Soon the purge air rotometers began to etch seriously, several corroding clear through; and again constant maintenance was required. This not being practical, a copper assembly was used as a temporary replacement, while fluorethane rotometers have been ordered. It is felt that these will afford a more permanent solution to the problem.

3) Hood 8 Furnace Water Jets

The suck-back of jet water into Hood 8 furnaces is another problem which presented early delays and necessitated mechanical attention. The first occurrence was in June during stand-in runs. At first this was attributed to improper sequence of valve operation, but this was soon disproven. Then surges in water pressure were suspected and orifices were installed in the water lines to the jets. At the same time fine mesh monel and stainless steel screens were installed in the suction and water inlet sides of the jet respectively to forestall the possibility of jet discharges becoming plugged. These two remedies

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combined to greatly lessen the suck-backs, and have not required any excessive maintenance in themselves.

4) Glass-Lined Equipment

Failure of glass and glass-lined equipment discovered prior to process start-up has already been described in preceding sections of this report (May and June, 1949). Failure of the glass liner of major pieces of equipment, however, has presented several difficult replacement problems and has been the cause of appreciable lost time. During September, failure of the glass liner of the lid of a recovery evaporator was determined. Replacement of this lid necessitated the erection, in Zone 2, of a large temporary plywood structure to serve as an air-lock. Due to the fragile nature of the equipment, the cramped work space, and the product contamination hazard, the work required two weeks for completion.

In October, the glass liner of the side arm of the recovery evaporator caustic scrubber was found to have failed permitting extensive corrosion of the iron. It was necessary to fabricate anew a portion of the lower section of the scrubber, as well as to procure a glass insert for which no spares had been provided. In effecting these repairs it was noted that the equipment was misaligned; this may have been the cause underlying the failure.

During December the lid of the evaporator in the other recovery hood failed, necessitating a repetition of the October job; another fume line failure occurred, and the glass-lined supernatant hold-up tank of one of the purification hoods failed. The reasons for these failures have not been definitely ascertained; nevertheless, the work involved in replacements has been considerable.

5) Casting Furnace Coils

The nine failures of the casting furnace coils during August and September caused delays of approximately two days each. Although physical replacement of the failed coils required but a part of a shift, cooling of the unit after each failure plus the time required to obtain the desired vacuum following repair necessitated the added delay. Close investigation of the problem, confirmed by subsequent laboratory analysis, disclosed that nichrome had inadvertently been substituted in place of the molybdenum specified for lead-in wire. Correction of this condition resulted in markedly improved performance of the coils.

6) Pressing

Mechanical difficulties in the pressing operation began during August with the failure of two dies. On one, the punch was cracked across one side of the primary plane and extending approximately one inch up the shank of the punch; on the second, both the punch and the knock-out plug were cracked. Investigation revealed improper alignment of the press in the hood; this was corrected.

Problems during the following period were more concerned with pressing temperatures and pressures; therefore, two failures of the press can

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heater nest during October were viewed with concern. Accordingly, the transite ring, which accommodates the cartridge heaters and buses, was redesigned to permit cartridge replacement without ring removal. This new ring was installed in November following another failure.

Pressing was finally operating in a relatively successful manner when new equipment had to be installed and calibrated due to the change in model in December. Much difficulty has been experienced in calibration of new dies supplied due evidently to lack of perfection in their manufacture. This fact, plus the lack of available equipment for adequately testing the dies, is at present seriously impeding the possibility of successful production of a Series C90 product in January.

7) Coating Equipment

The mechanical problems of the coating hood equipment may be summarized as tripped and high vacuum difficulties.

Operation in Hood 26 was begun late in August following several months of continuous effort in eliminating leaks in the high vacuum system. These efforts in Hood 25 were not so successful, however, and it was not until the end of November, more than four months after efforts were originated, that satisfactory high vacuum conditions were obtained.

A large share of the difficulty experienced in eliminating leaks in the high vacuum equipment was attributed to reported failure, with necessary attendant repair, of the mass spectrometer used in leak checking. This proved to be a great delay in November when, following the explosion attributed to admixture of the coating gas with air, it was necessary to test gas piping as it was reassembled.

The tripped difficulties, evidenced by frequent failure, during operation, of the main shaft pin, were finally attributed to binding at a point where the prongs enter a triangular guide plate. Dressing of the prongs at such points effected improvement, but it became necessary to provide permanent alleviation by installing bronze bushings at the points of contact in order to eliminate stainless on stainless steel contact.

C. Special Hazards

1) Contamination Control

While control of the spread of contamination is a problem inherent to any operation concerned with the processing of radioactive materials, the specific difficulties encountered, particularly in Building 234, have contributed largely to much delay and inconvenience experienced in that operation.

Though there have been isolated incidents of contamination spread in the several operating sections in these months subsequent to start-up a discussion of this problem in Buildings 234-5 becomes essentially a consideration of Zone 3, Building 234; it is this which is reviewed here.

During the initial weeks of operation it became evident that the air

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looks provided on the purification hoods were wholly inadequate to prevent spread of contamination outside the hoods. There were several instances of floor contamination, all requiring extensive cleaning efforts, and it was quickly ascertained that the full-time use of respiratory protection was required due to positive air contamination. Revision of the filter arrangement on these hood air lock doors has aided somewhat in controlling this problem, but frequent maintenance, particularly in early months of the transfer vacuum system, contributed almost constantly to the increased spread of contamination. A structure to enclose the rear of the purification hoods and the process piping outside these hoods has been designed; preparations for its installation are now underway. This will provide essentially an extension to the hood which will provide for all process piping and equipment to be separated from the operating area. Such principle is mandatory, and the design of this equipment without it has been one of the most serious impediments to successful operation.

During September, gross contamination of the floor in Zone 3 occurred when leaks developed in instrument lines as mentioned earlier in this report. This contamination was spread to corridors and locker rooms due to the lack of thorough training and follow-up on the rigid controls so necessary. While this incident required loss of process time to permit cleaning, it is of interest to note that subsequent incidents of Zone 3 contamination, although serious, have been confined to the rooms involved and not spread to other sections of the building.

During the following month, these occasions continued but were due chiefly to maintenance work on equipment in Zone 3. One incident occurred when air flow conditions were upset due to the failure and slipping of a damper, but since the greenhouse was being designed, it was felt that the time and effort expended in decontamination were hinderances of a temporary nature.

The extent of contamination in November was greater than at any previous time, there being four incidents of gross severity attributable either to mechanical failure of, or imperfections in, equipment, or to the subsequent maintenance necessary. The most extensive incident, in which contamination ranging in spots up to 1×10^7 d/n was encountered, presented an almost insurmountable clean-up problem. All operations were suspended due to inability to approach the hoods, and entire shift crews were pressed into service in efforts to decontaminate the floor. Finally, paint removal was necessary, fixing of residual contamination by the application of two coats of paint followed, and then G. E. Cocoon was applied over the entire area. This is an easily removable material and greatly facilitates decontamination work. Removal of a portion of this cocoon was necessary in December following another incident of contamination, but its relatively non-porous properties have thus far eased the problem while awaiting installation of the greenhouse.

These are the highlights in a story of contamination control. The lost processing time, the hours of hard, unpleasant work under uncomfortable conditions, and the ever-present potential health hazard have had serious effect on the progress of this operation and on the morale of employees concerned. It has been helped considerably by the application of cocoon;

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the greenhouse installation should provide an arrangement which will make these conditions more in line with the standards met in the other facilities in the area.

2) Glove Failures

One item which should not go without mention as a separate problem is that of replacement of rubber gloves used on the process hoods. These gloves fail due to wear against equipment handled, undue stretching, flaws in the material, and for reasons the exact nature of which is difficult to define. Any break, however small, becomes an immediate source of potential contamination of the entire work area; therefore, a very close and exacting control must be maintained at all times.

Marked progress has been made in this respect through the continued training efforts of operating supervision; it is only through the relentless continuance of such control that safe continuity of this type operation may be realized.

The glove replacement totals are in excess of the actual glove failures, but there have been occasions of gross contamination of other gloves from one which has failed. This problem has also been accorded close surveillance and is considerably improved.

During 1949 operations, there were 172 glove replacements in the six months of operation. There were, however, but 22 in November and 18 in December.

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