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HEALTH PHYSICS ASPECTS FOR SPRU OPERATION
AT LEVELS OF ACTIVITY GREATER THAN FIVE PER CENT

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By: L. L. Gorman

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HEALTH PHYSICS ASPECTS FOR SPRU OPERATION
AT LEVELS OF ACTIVITY GREATER THAN FIVE PER CENT

In light of present thinking concerning the operation of SPRU at levels of activity higher than the 5 per cent Hanford level, it is advisable to review previous operations at the 5 per cent level from the health physics viewpoint, and to promulgate, where suitable, certain points with respect to operations at higher levels. The opinions expressed are based on actual operating data that have been reported in numerous Health Physics Division publications including Biweekly and Monthly Progress Reports.

To simplify this discussion the basic assumption is made that characteristics of SPRU operation such as flow patterns and quantities, decontamination factors and metal age for the higher levels would be the same as those used during the 5 per cent runs. Such an assumption is intended to preclude all variables other than activity levels. This assumption appears reasonable; however, it leads to an optimistic appraisal of situations that could arise as variations in these characteristics at the higher levels of activity would undoubtedly increase the hazard potential.

Radiation Hazard Evaluation
Building G-2

The more significant instances of potential radiation exposure have occurred in the cells during inspection and maintenance and in the sampling aisles during the use of samplers with inadequate shielding. Several other locations and operations, however, would involve significant dose-rates if extended to full Hanford level.

Dose-rates in Cell 1 during personnel entry have ranged from 200 mr/hr at three inches from the empty 304 tank to 3000 mr/hr at four feet (estimated 12 roentgens/hr at 12 inches) when the tank was in use. The 1A feed pump has indicated levels of 2500 mr/hr at eight feet, and the 1A filters in Cell 1 have produced relatively high dose-rates, 1500 mr/hr at three inches after decontamination. The cleaning of these filters appears necessary and unfortunately, difficult from a maintenance standpoint. Dose-rates as high as 7000 mr/hr have been reported from the sump pump in Cell 1, which after decontamination was 2700 mr/hr. The survey measurements reviewed here are the higher measurements that have been reported and are not necessarily indicative of the only sources which could be limiting at higher levels of activity.

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The extension of these dose-rates to full Hanford activity poses a very significant increase in the radiation hazards that are encountered in this cell. Recent maintenance work in all cells involved many problems in this respect including the undesirable provision of permitting individuals to receive weekly dosages in one day. There is no indication that the cell maintenance problems will become less in number or degree. In fact, the converse is more probable due to continuous use and wear of equipment. Full Hanford activity in these cells will undoubtedly make it necessary to deny access to the cells until more complete decontamination can be accomplished than has been under previous conditions. Further, it must be recognized that the practice of permitting maintenance and operations personnel to receive weekly dosages in exposure periods less than one week is uneconomical from the standpoint of manpower availability, in addition to being a point of risk and weakness in the hazard control program.

The problem of the sampling units and process samples is quite similar with respect to radiation hazard evaluation. Currently radiation levels in both the upper and lower sampling aisles are higher than is desirable unless more rigid methods of personnel control are instituted. Dose-rates of 50 to 250 mr/hr at three inches from the sampling boxes have existed without too much success in shielding. Dose-rates during sampling operations have been a maximum of 21 rep/hr and 280 mr/hr at three inches. Several of the process samples have produced dose-rates of this magnitude imposing problems to both the sampler and the analyst. A review of the hand exposure data indicate that there have been recorded two instances of over-exposure to the hands of operations and analytical personnel handling SPRU process solutions since start-up. Ten cases of hand overexposure have been reported for analytical personnel working on process streams in some of which the activity approached 40 per cent Hanford level.

Not only does the activity of the process samples present a radiation hazard at the times of sampling and analysis, but the decontamination of sampling equipment has created a radiation problem which in part is due to the limited facilities provided for this work. Dose-rates of 27.5 rep/hr at 1 inch and 175 mr/hr at 4 inches have been encountered recently in such decontamination operations. Samples with a proportional increase in activity for full Hanford level could not be handled safely by the existing equipment. Further, it would appear that remote decontamination facilities may be required for higher levels of operation.

Building H

Whereas, upon first consideration, the increased level of activity processed in SPRU might be considered to have little effect upon the radiation hazard control program in Building H, such is not the case. Since none of the first cycle SPRU wastes has been processed completely through the Building H cycle, the problems that could be encountered due to higher levels of activity cannot be evaluated fully at this time. Several areas of high level radiation

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now exist, however, following 5 per cent operations. Due to present practices, the activity in the 525-A tanks (laboratory waste receivers and evaporator feed tanks) has produced dose-rates as high as 1000 mr/hr at three inches. High measurements on the unshielded east evaporator have been reported, 145 mr/hr. Higher measurements have been reported on the shielded west evaporator. These measurements do not reflect improper use of equipment; however, they do indicate requisite alterations in operating procedures either to provide additional shielding, or to use exclusively those equipments that are now shielded. Again the hazards of maintenance are foremost and must be evaluated fully with protective and counter measures provided before SPRU operations include any increase in activity.

A significant item of concern with respect to higher SPRU activity and Building H is the concentrated waste products. To date waste concentrates have been packed exclusively in the unshielded 30 and 70 gallon drums. Dose-rates already have exceeded 1 roentgen per hour at 3 inches from these drums. These levels of activity not only present radiation hazards within Building H, but they also represent hazards which are more significant during the transport and storage phases of the waste handling program. The KAPL waste handling facilities are at present definitely inadequate for handling safely solid wastes of proportionately higher activity. Should the activity in SPRU wastes increase, a larger quantity of these wastes, including decontamination effluents, will have to be stored in the tank farm, or shielded containers will have to be provided to facilitate handling and storage. In either case, a close scrutiny of the economics involved is required as definite changes will be required with increased activity of SPRU wastes.

Contamination Hazard Evaluation

Surface Contamination

Building G-2

The surface contamination problem is commensurate and common to the radiation exposure hazard and perhaps should not be dissociated in discussion. Since it does exist as an independent form of radiation hazard, and is particularly significant in an operation such as SPRU, its separate treatise appears justified.

A review of the data reported reveals that there is hardly an area in Building G-2 that has not been involved with surface contamination. In such locations as the cells, the hazard potential is a difficult picture to resolve since the radiation levels from other sources interfere. However, the incidence of leaking pipe connections, valves and pumps has produced significant levels of floor and equipment contamination which has led to personnel, clothing and access way involvements. The incident producing the maximum reported dose-rate of 30 rep/hr including 400 mr/hr at 3 inches was reported in Cell 1. Clothing contamination has been as high as 350 mrep/hr and 850 mrep/hr on coveralls and gloves respectively. Cell access aisles have had levels of surface con-

amination up to 40 mrep/hr. Whereas the SFRU design permits the decontamination of internal surfaces of vessels remotely, the removal of contamination external to such equipment is not feasible without personnel entry. At such times, the hazard potential is greatest, and higher levels of activity only increase this potential in addition to adding inconvenience to the inspection or maintenance program.

Surface contamination in the sampling aisles has been quite extensive but well controlled due to the use of protective floor covering. Dose-rates of 30 to 40 rep/hr have been encountered on protective floor coverings. Spills inside the sample boxes, however, contribute greatly to the radiation background from these units and are difficult to remove. The contamination levels on sampling equipment, as mentioned previously, have already reached 27.5 rep/hr at contact including 175 mr/hr at 4 inches. The decontamination of these items in the present facilities at extended activity levels is inadvisable according to good health physics practice.

A review of the surface contamination should not neglect those instances where significant levels of activity have been encountered in the pseudo "clean" areas such as the control room and the motor generator room due to malfunction of process equipment. Dose-rates of 1500 mrep/hr including 80 mr/hr from the blow-back of the I AP manometer in the control room are controlled easily when the malfunction is identified in time and necessary measures of precaution are administered. Hazards from such instances can be extensive, however, and increased levels of activity would contribute greatly to the potential risk. It is reasonable to consider instances of this type as "risks of operation;" it is equally as reasonable, and more important, to question whether or not all malfunctions have been determined in the SFRU system during the 5 per cent operations.

The contamination of the sumps, floor and gang valves in the motor generator room has occurred in two such instances of malfunction. Until the circumstances of these incidents could be evaluated fully, the health physics picture was in a rather precarious state requiring complete utilization of protective devices in one case for a period of forty-eight hours. Such inconveniences must be accepted with the "risk of operation," and it is reasonable to promulgate that higher levels of activity could produce conditions which would exclude completely personnel entry to certain areas for limited periods of time. Although the levels of activity involved at the 5 per cent level were low, the malfunction which permitted the contents of the A-541 (cross-over receiver, Cell 5) tank to back-up in the sampler and over-flow further emphasizes this phase of the problem.

Airborne Contamination

Hazards from airborne activity are contiguous with the picture of surface contamination; consequently, throughout the process areas of both Buildings G-2 and H conditions requiring assault masks have been prevalent. In addition to

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the normal, or anticipated problems of airborne activity in process areas, recent plutonium contamination encountered in the rotometer aisle due to the location and malfunction of a vacuum control valve (second cycle plutonium decontamination in cell 5) justifies the expression of concern stemming from incomplete evaluation of process equipment with respect to malfunction. At higher levels of activity and similar contamination problems, assault masks will have to be replaced by Chemox masks or some form of respiratory protection providing an independent supply of fresh air. Extensive use of respiratory protection of this type is at best an inconvenience to routine operations and a serious restriction in the case of maintenance work. Involvements of this nature increase greatly the risk of operation and the justification of risk requires unquestionable substantiation.

The problems of airborne activity with respect to the G-2 stack appear to be of less concern should one be permitted to assume that the dissolver scrubber will continue with present efficiency and the vent scrubber efficiency improves through the use of caustic. One qualifying exception should be considered here. Despite efforts to preclude the radioactive particle problem in the SPRU effluent, there are some data now available that indicate that the problem possibly exists to a small degree.

Entrained activity (entrainment exists despite the condensate traps in this system) could be the source of what appears to be radioactive airborne particles. In any case, the removal of such condensation from the stack effluent is desirable. Radioautographic studies must be extended before the confirmation and degree of this hazard are determined.

To date the maximum values reported for stack effluent have indicated discharge concentrations as follows:

Alpha activity	--	4.9×10^{-13}	$\mu\text{e/cc}$
Nonvolatile fp	--	4.6×10^{-6}	$\mu\text{e/l}$
I-131	--	2.2×10^{-7}	$\mu\text{e/l}$
*Kr-85	--	8×10^{-3}	$\mu\text{e/l}$

Once more the optimistic assumption is made that filter efficiencies, scrubber efficiencies and ventilation equipment operation at full Hanford level should be the same as demonstrated at the 5 per cent level (with the exception of anticipated improvement in the vent scrubber system).

Extending the above values to levels anticipated for full Hanford level would give an alpha concentration approximately 30 times the accepted maximum permissible level (mpl); a nonvolatile fp concentration 920 times the mpl value for mixed fission products; an I-131 concentration slightly higher than the

*Estimated in Memo-LLG-6 as 9×10^{-3} $\mu\text{e/l}$. This correlation is perhaps more a coincidence than actuality since SPRU operation has not conformed with the dissolving pattern assumed in these calculations.

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mpl value; and a Kr-85 value approximately 16 times the accepted mpl. In all cases, it would appear reasonable to assume these as "acceptable" values for discharge. As indicated in Memo-LIG-6, Considerations in Determining Stack Height for Building G-2, July 12, 1949, a SPRU stack 100 feet high should provide a dilution factor of 3105 with the distance of maximum ground contamination at 1000 feet from the stack. Effluent concentrations of this magnitude, however, are an over-extension of the "KAPL policy" with respect to the discharge of radioactive waste materials from the laboratory. This division, as well as members of laboratory management, has highly endorsed this policy in announcements to both the general public and the Commission. A restatement of this policy, appears to be in order.

Conclusion

The projection of a program such as encountered in the SPRU operation for hazard evaluation is none too finite. In many respects, the hazard evaluation for full Hanford level produces a pessimistic picture. The "risks of operation" in other cases appear surmountable, but indeterminable from a paper study such as this.

In many respects, with proper preventative maintenance before the higher level runs were made, perhaps the faults and malfunctions could be removed. Recurring malfunctions have evidenced that such has not been the case at the 5 per cent level.

In any respect, for continued operation of SPRU at the 5 per cent level, and most certainly prior to any increase in activity level, a complete and imaginative survey of the SPRU operation and equipment for defects is required. Such a survey is difficult to accomplish, again as evidenced by the recurring incidents of malfunction.

To operate SPRU at levels of activity higher than 5 per cent poses undesirable increases in the hazard potential. To jeopardize the hazard control program under present conditions of KAPL operation is strongly questioned. To determine the feasibility of diminishing or removing this state of jeopardy at the increased levels of activity requires a separate study. Such a study is required of operations personnel who must be satisfied and confident of the advisability of such action. Certainly any technical program proposing such action must be of uppermost importance, and it should be unquestionably validated as to its contribution to the laboratory program.

L. L. German
L. L. German
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