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REFURBISHING OF THE HIGH ACTIVE HANDLING FACILITIES AT BERKELEY NUCLEAR LABORATORIES

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1. INTRODUCTION

Berkeley Nuclear Laboratories provides facilities for the detailed examination of highly radioactive materials in support of the power producing reactors operated by Nuclear Electric.

The laboratories were opened in 1962 and the cave system was first used for the examination of Magnox Fuel Elements. Since that time, approximately 15000 elements have been examined and approximately 1500 of these sectioned for metallographic examination. Magnox fuel examination ceased in 1986 and the caves are now in the final stages of a major refurbishment programme to provide PIE facilities for the Advanced Gas Cooled Reactors (AGR) (Ref 1). The refurbishment of the active facilities also includes rebuilding work and construction of new cell lines and this work has been substantially completed. The only major areas where decontamination is at an early stage is the refurbishment of the fuel element receipt pond.

This paper will deal principally with the procedures used for refurbishing the cave system and its associated ventilation plant. It was decided at the outset that the extent of the work exceeded the resources available locally and contractors were employed to carry out the refurbishment under the control of a Nuclear Electric project team (Ref 2). The other important decision was that operational work would continue in areas unaffected by the refurbishment. This has imposed considerable demands on supervisory staff to ensure continuity of work. The replacement of the active ventilation plant with only a minimal affect on day to day operations has been a major achievement.

2 CAVE DECONTAMINATION

The layout of the cave system is shown in fig 1. The current situation is that cave 1 and Caves 4 to 6 have been decontaminated and are in the process of being re-equipped. Caves 2 and 3 continue in operation and will be taken out of service later this year when the refurbished caves are available.

Prior to man entry activity levels were reduced considerably by removal of contaminated equipment and of bench plates. Decontamination using detergent foam introduced by lances from the cave roof successfully removed activity on the walls and crane rails but since the work surfaces were not sealed it was difficult to prevent activity being washed onto the floor. In the areas where the fuel element cutting machine stood, the bench had been covered by stainless steel trays. This proved invaluable since removal and size reduction of these trays resulted in a major reduction of the bench top activity.

A number of decontamination techniques were used on the bench tops such as detergent foam, fluorocarbon liquid and solvents applied by remotely operable cleaning machines. These were used to reduce bench top activity to a level where the bench plates could be removed for size reduction and hands-on decontamination (Ref.3). By this means it was possible to dispose of the complete bench structure as low level waste.

As the benching was not sealed to the walls, it was found that the cave floor was heavily contaminated. This was not surprising as two of the caves had been in daily use, without man entry, for a period of approximately 15 years. Although some floor cleaning was achieved with a power manipulator and special tools, there were considerable areas that were inaccessible and these could only be cleaned by man entry. After the initial clean down with long handled tools conventional floor cleaning machines proved extremely useful in reducing contamination levels. In this application the availability of a robotic cleaning device would have been invaluable in reducing personal doses and cutting down the time required for cleaning.

The objective of the work was to decontaminate the caves to a level where entry without respiratory protection was possible. This was achieved under still air conditions but it was found that once refitting work started, airborne activity rose unacceptably so that this work had to be carried out in respirators. The current position is that the re-equipment of Cave 6 is well advanced and that it is expected to return to active use at the end of this year. When this is done, Caves 2 and 3 will be taken out of service for remote decontamination and refurbishment.

Re-equipment of caves 1, 4 and 5 is progressing to target and these will be returned to service in 1991. The last active work was carried out in this line in 1986 so that the refurbishment project will have taken 5 years. Without the assistance of robotic devices capable of continuous working, it is difficult to see how this time could have been shortened without an increase of 3 to 4 times in manpower resources.

3. HEALTH PHYSICS ASPECTS

Although the in-cave work was carried out by contractors, all entry supervision and health physics monitoring was controlled by BNL staff. This proved an arduous task and availability of health physics manpower frequently proved to be the rate limiting step in the achievement of project timescales. Careful planning was necessary to meet both refurbishment and operational needs and despite this it was impossible to prevent local peaks of demand occurring which could only be met by extending timescales.

At the completion of remote cleaning typical in-cave radiation levels were in the range 5-8 mSv per hour and the first man intervention was achieved using long handled tools. The availability of sliding doors which could be partially opened so that the operators could work from a shielded location was a considerable advantage. Access from the cave roof via removable shielding blocks was also valuable as it was possible to carry out high level cleaning without direct man access.

Bench plates and equipment that could not be dismantled and removed remotely were carried by the in-cave crane to a low dose location at the end of the cave line for further decontamination and size reduction. Particularly useful was a plasma arc torch which could be used in a partially remote manner so that the operator could stand away from the work while it was in operation.

With all equipment and benching removed typical radiation levels fell to less than 1 mSv per hour and at this stage extended man entries were carried out to clean the walls and floors. These entries lasted approximately 4 hours and were dictated by the length of time that a man could work comfortably in a ventilated plastic suit. At the completion of this phase, activity levels had dropped to 100 micro Sv per hour.

Following repainting of the walls the airborne activity had dropped to free breathing levels. However, when re-equipment began it was found that the movement of operators and equipment within the caves lifted airborne activity levels unacceptably and despite extensive further cleaning of areas where loose activity was thought to be located, it proved impossible to maintain the airborne levels consistently within the free breathing limit. i.e less than 0.1 DAC For this reason the re-equipment had to be completed in respirators.

4. LESSONS LEARNED FROM THE REFURBISHMENT

It became apparent at an early stage that the unsealed cave benching had allowed extensive contamination of the floor and this was a major problem. On the positive side, the use of remotely removable bench covers in areas where high contamination was likely e.g. fuel element sectioning considerably reduced the time required for decontamination. During the remote decontamination stage it was difficult to find a suitable monitoring instrument that would allow rapid checking by the operator of the progress of decontamination. This is obviously an area that needs further consideration.

Most of the in-cave equipment was free standing on the bench top and could be dismantled remotely. This was extremely important in reducing man doses. In particular the fuel element cutting machine, which had been in continuous use for approximately 14 years, was fully dismantled and disposed of remotely. Unfortunately, some large items of equipment existed e.g. a baling press for size reduction, that were bolted to the cave floor. These proved particularly difficult to deal with and all this type of equipment has been eliminated in the refurbishment.

During the remote dismantling phase, many non-standard tasks were carried out and this substantially increased the number of manipulator break-downs. The availability of a power manipulator and an in-cave crane alleviated the problem but did not remove it. In the early stages of man entry, time was saved by releasing bolted down items during an entry and then using remote means to carry these to a low dose disposal area when the entry was complete.

5. PROJECT MANAGEMENT

Although this paper deals with the Cave refurbishing there has been concurrently, the replacement of the Ventilation Plant throughout the Shielded Area, the construction of two Cell lines, refurbishment of the effluent treatment plant and substantial civil works associated with the improvement of old buildings.

Most of these works were combined into a Refurbishment project with the intention of ensuring that all major works were undertaken together. A small, dedicated Project Management Team, drawn from NE's Projects Division, has been involved in the Project since 1986 engaged principally in the planning and co-ordination of all the work, financial reporting and control. The team also administered most of the contracts on the Project.

In spite of the realisation that the Project would need extensive co-ordination and place some strain on BNL's resources, the interactive effects of the man entry for cave decontamination and associated contamination and access problems on the other contracts have distorted the original Project Plan. In particular, the local supervisory effort required to control all the activities was underestimated. These aspects have made the attainment of project target dates difficult though it is noticeable that since the completion of the main cave entries, the strain on resources has significantly decreased and most of the non-Cave work is nearing completion. The problems were exacerbated by the need to keep other active operational areas functional and it was a major achievement that there was no significant loss of operational time in these areas and that it was possible to increase the throughput of these by approximately 25% during this period.

6 CONCLUSIONS

Although this refurbishment project was planned in detail by an experienced project team, the unforeseen changes that have occurred during the 5 years of its operation have created major problems that have required considerable ingenuity and effort from the staff to surmount. Some of the changes that have had a major impact are:

1. Change of ionising radiation units.

   At the beginning of the project every health physics monitoring instrument had to be recalled for modification.

2. Revised ionising radiation regulations.

   These regulations govern all work with radioactive materials and impose stricter control procedures. Thus, just as the project had started operating systems had to be changed and all staff retrained.

3. Change in low level active waste disposal arrangements.

   Completely new arrangements for monitoring and packaging low active waste were introduced soon after cave clearance was started. These had to be incorporated into operating procedures without delaying the cave entry programme.

4. New advice on personal dose limits.

Although not mandatory the proposals suggested that dose limits should be substantially reduced. Fortunately the procedure that had been adopted at Berkeley Nuclear Laboratories meant that we were, in effect, already working to these limits.

5. Revised Site Licence Requirement.

This required a rewriting of operating procedures in a format that was auditable by Quality Assurance Techniques.

6. Government Plans for Privatisation.

A major restructuring of the electricity supply industry took place as a prelude to movement from the public to the private sector.

Despite all these difficulties it has been possible to meet project completion dates.

7. REFERENCES

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8. ACKNOWLEDGEMENT

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*Residual air born activity

15 mSv/year

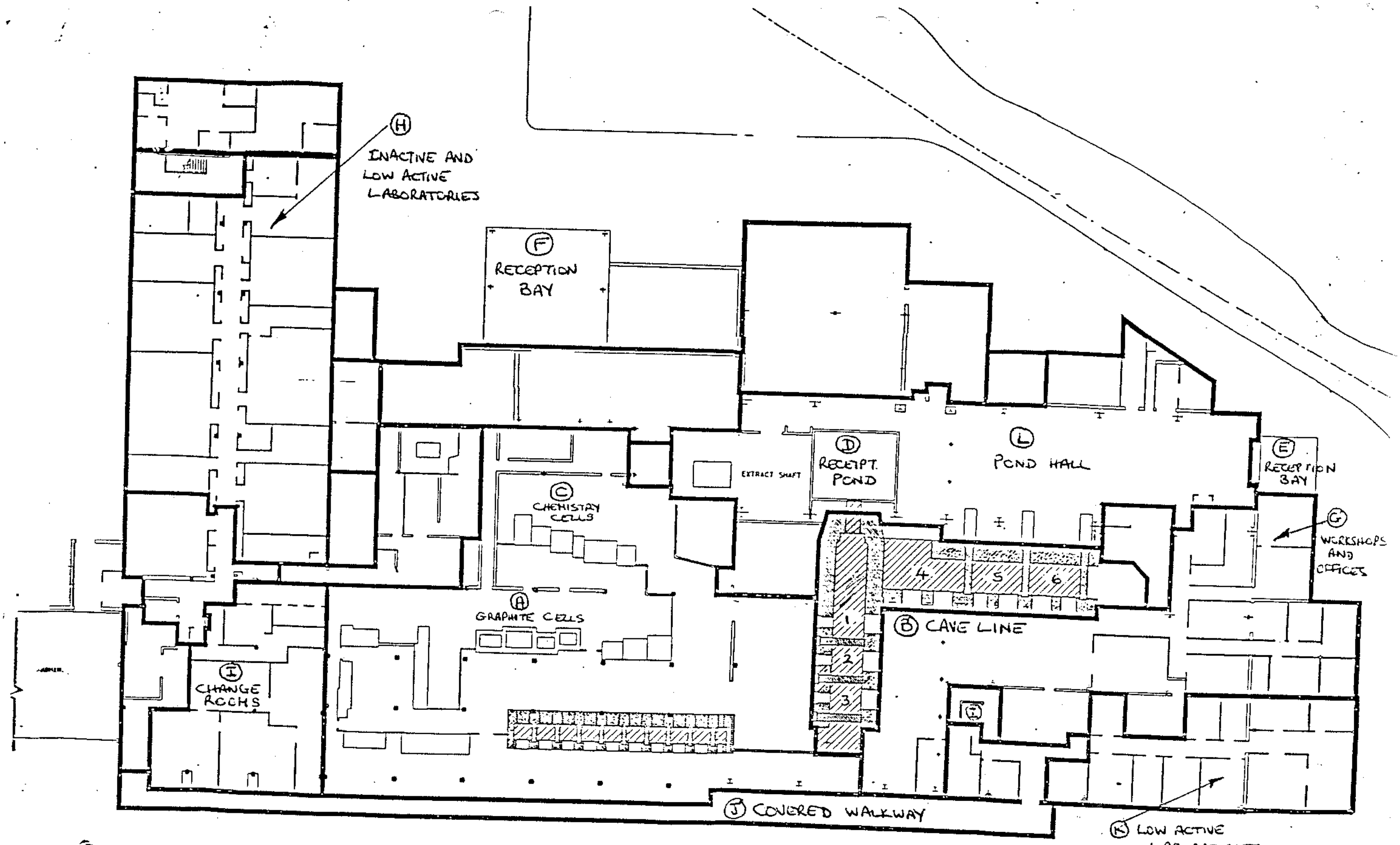

FIG.1 LAYOUT OF SHIELDED AREA